Popular Science

The What's New magazine

Feed logs to your oil burner?

MULTI-FUEL HOME FURNACES

New $595 home computer

Low-cost models can change your life-style

GM and CHRYSLER for '78 -the shrink goes on

First really promising U.S. MAN-POWERED AIRCRAFT

VW's 60-MPG TURBO-DIESEL SAFETY CAR

Our changing weather: COLDER WINTERS AHEAD?

Introducing the wagon that has America singing.

You guessed it.

After all, you don't find people singing about ordinary wagons. Just extraordinary ones. Which, we modestly propose, is precisely the category the 1978 Plymouth Volaré wagon fits into.

Reason number one is the most obvious. That cavernous space you see below. Where those kids could lug home about 60 bushels of shells, or fish, or something else suitably exotic. (Parental guidance suggested.)

Of course, the nice thing about lugging anything around in a Volaré is that you never lug around a lot of car. Because Volaré is a trim, compact wagon. Maneuverable. Easy to park. And, a pure joy to drive. Thanks to the Isolated Transverse Suspension. An ingenious system designed to keep life's bumpy road as far away from you as possible.

Other comforts also abound in Volaré. Like a gas pressurized liftgate that opens part way on its own. And two optional lockable storage compartments to keep "out-of-sight" valuables out of sight.

Volaré. People have been singing its praises since the day we brought it out. So much so, in fact, that last year, they helped make it the No. 1 selling wagon in America.

And if we're hearing it right (ah, what a great sound) that's exactly where it's going to remain.

Buy or Lease a Volaré at your Chrysler-Plymouth Dealer today.

New 1978 Plymouth Volaré.
The car with the accent on value.

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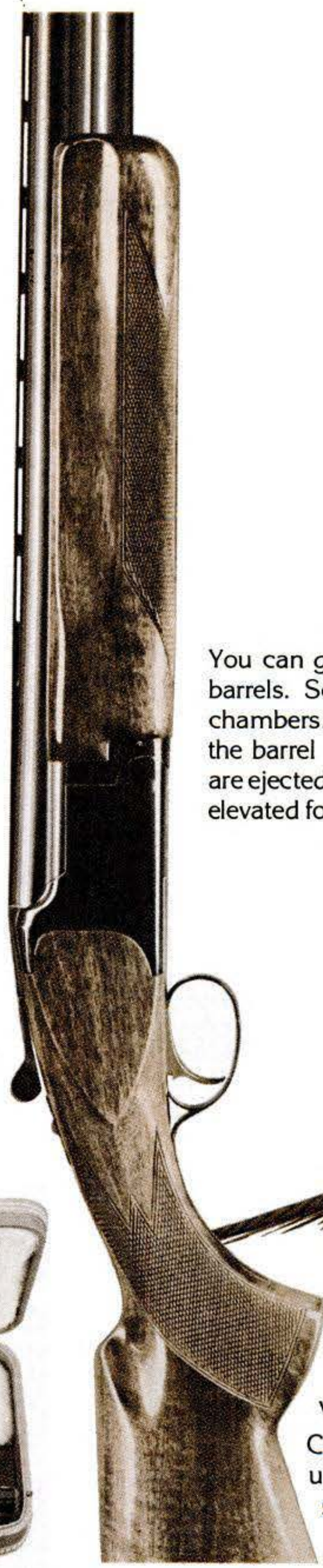
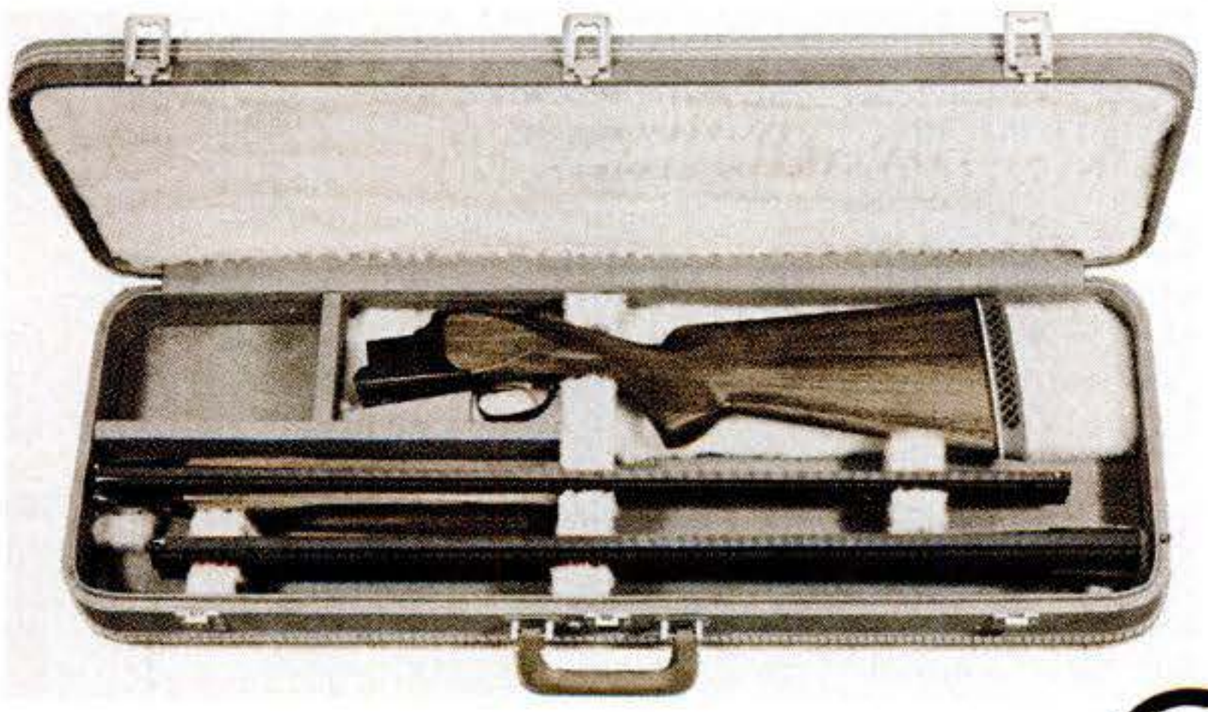
Browning workmanship and a $462.50* price tag make the Browning citori your best buy in an over/under shotgun.



The Citori gives you Browning's heritage of over/under craftsmanship and dependability for $462.50*. The solid steel receiver and barrels are machined to exact tolerances. The locking bolt is tapered to a precise angle. As it wears, it seats deeper into the breech block, keeping the barrels locked tightly to the receiver. Hunt after hunt. Year after year.

The Citori is Browning through and through. All metal is finely polished and exterior surfaces are deeply blued. The beavertail forearm and full pistol grip are hand checkered, 20 lines to the inch for a good grip. And the trigger is gold plated. Your Citori can only increase in value.

You can get your Citori with 26", 28" or 30" barrels. Select 12 or 20 gauge, all with 3" chambers. A barrel selector lets you choose the barrel you want to shoot first. Fired shells are ejected for fast reloading. And unfired shells elevated for rapid unloading or changing.



For added versatility, you can have a 12 gauge Citori with an extra set of 20 gauge barrels in a fitted luggage case for $792.50*. 12 & 20 gauge Skeet Combo $872.50*. 12 gauge Trap Combo with high post ventilated rib. $842.50*.

Compare a Citori to any other over/under at your Browning Dealer's. You'll see why the Browning Citori is your best over/under buy.

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This One

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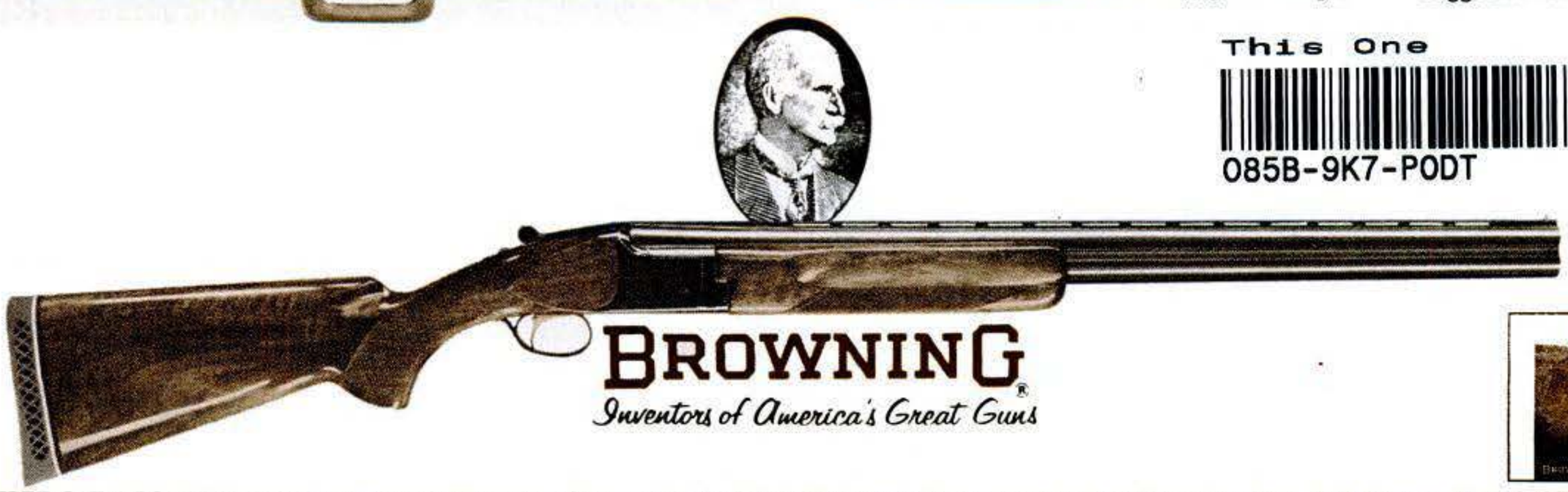

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Popular Science

MONTHLY®

The What's New magazine

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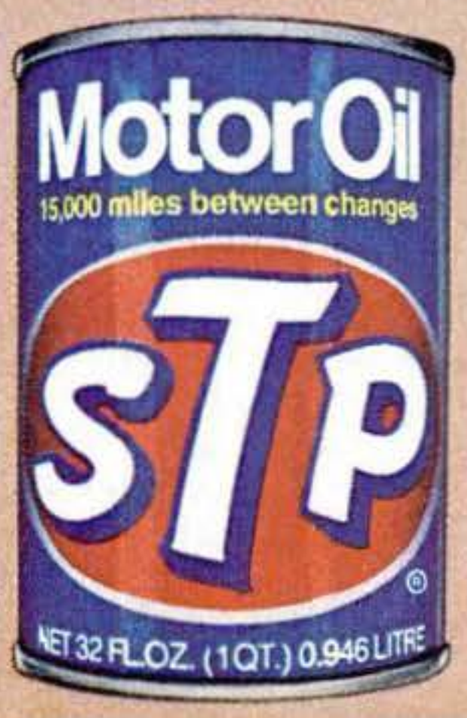

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PS READERS TALK BACK

Address letters for this column to: Readers Talk Back, 380 Madison Ave., New York, N.Y. 10017. Because of the large volume of mail, we are unable to acknowledge unpublished letters.

Good marks for attic fans

After talking with several installers, I decided to use attic fans [PS, Aug.] in lieu of installing costly central air conditioning. My house is approximately 2000 sq. ft. with a peaked roof. At each end is a gable vent. This is where we put the attic fans.

In the west end of the San Fernando Valley, where we live, the summers can be hot, with temperatures averaging above 80°, but peaking at almost the 110° mark. And that's out in the air! When the temperature is 80° outside, it is over 100° in the attic.

First, we had an additional three inches of rock wool blown into the attic, and then installed the fans. Recently these fans were advertised by a West Coast hardware chain at $39.97 each (with thermostat). They are made to fit in back of the ventilators, fitting the 16-in.-on-center studs, with a pigtail to the thermostat (set at 100°). You hook the pigtail into a regular 110V line.

Our experience with these fans has been nothing but good. With temperatures in the 90's, the inside temperature has been at least 10° less without air conditioning. With temperatures soaring into the 100's, we have been able to maintain a mid-80° temperature in the house using the air conditioner, a 1½-ton window unit. Without the attic fans, when it reached 100° outside we were lucky to get down to the mid-90's inside. Believe me, we are well pleased with the addition of attic ventilating fans.

C. B. Conard, Reseda, Calif.

5-in-1 engine

In these days of fuel shortages and energy crunches I often lament my need for a full-size, eight-cylinder automobile. I would much rather drive a tiny, economic subcompact, both for the savings to my pocket and to conserve energy. But because of my occasional need for the 350-cubic-inch monster (and gas-guzzler) beneath the hood of my 1973 Chevrolet station wagon, I must opt for the larger, less efficient, less economical automobile. The ingenious 5-in-1 engine, reported in your July issue, is really a glimmer of hope for those like me who must run a large engine all the time when it is only needed some of the time.

Carolyn Hoffman, College Point, N.Y.

Your article on the 5-in-1 engine didn't cover one question: Assuming that the four cylinders that always work are always the same four, wouldn't you end up with uneven wear—more on the basic four, less on the others?

James W. Phelps, Evergreen, Colo.

E. F. Lindsley replies: "Naturally, this possibility has been considered, but Eaton engineers said that so far the wear difference has not been apparent in test cars. They have, however, the capability of programming the selector so the same cylinders would not be used in the same sequence each time. What you call 'the basic 4' can skip around."

Four disks or two?

In your August car test you say that the Lincoln Versailles had four-wheel disk brakes, but in the spec table you list it as having only front-wheel disks. Shouldn't it be disks all around?

Gerard Vincent, Manhasset, N.Y.

Whoops! Our spec table is in error. All Versailles come with four-wheel disk brakes as standard equipment. Sorry for the confusion.

De-mudding records

First, I would like to thank you for your article on record cleaners [June]. It at least explained what is wrong with 35 or 40 of my records. My cleaner dissolved the dirt and antistatic chemicals I had previously used, and the resultant mud has clogged up the grooves. However, the article didn't tell me what to do about it. Help!

Wayne L. Berry, Ft. Walton Beach, Fla.

Harry E. Maynard replies: "Mr. Berry's problem sounds like a classic description of the problems of the wet-play method, covered in the story. My sug-

Continued

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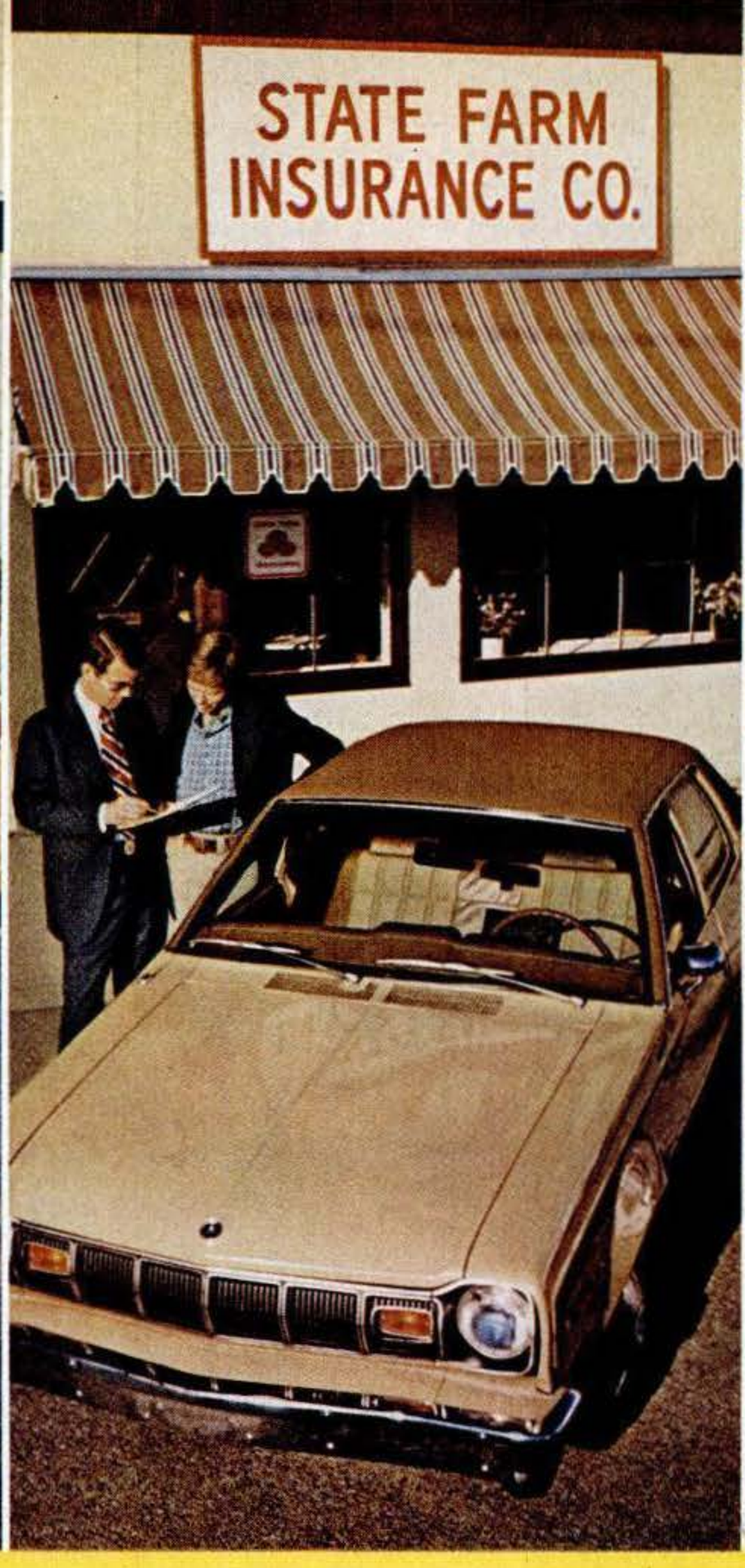

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gestion for removing the mud: First try a mild cleaner, such as DiscWasher's Fluid II (with the company's brush). If this doesn't offer noticeable improvement, try the harsher 50-percent alcohol and double-distilled-water solution. As a last resort, wash the record, as described in the article.

Press-N-Set discontinued —temporarily

Unfortunately, Press-N-Set, the pressure-sensitive system ["Easy Route to a DIY Ceramic Tile Floor," PS, July] for installing ceramic floor tiles, has been discontinued, because our supplier of adhesives and core material has gone out of business. We are actively pursuing a new source of supply, but until such becomes available and is tested thoroughly by our laboratory, we will not be able to offer a similar product. We are keeping all inquiries and will notify the writers when Press-N-Set again becomes available.

Louise T. Brennan,
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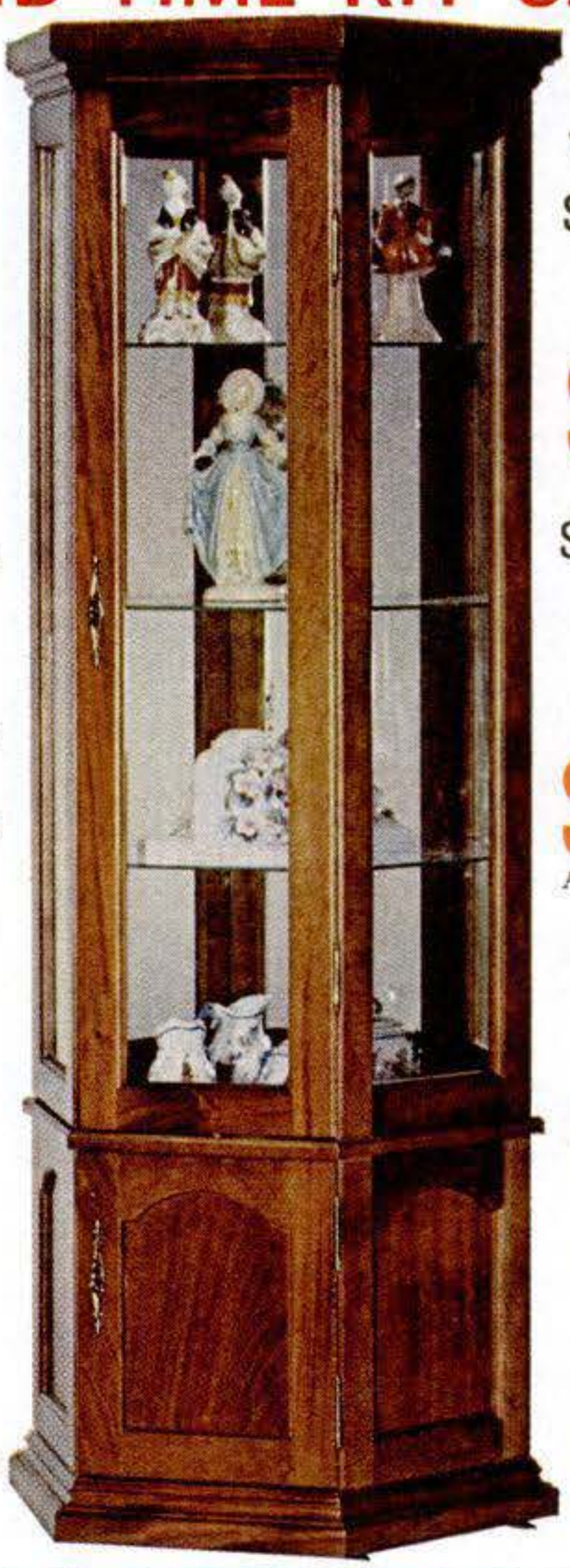

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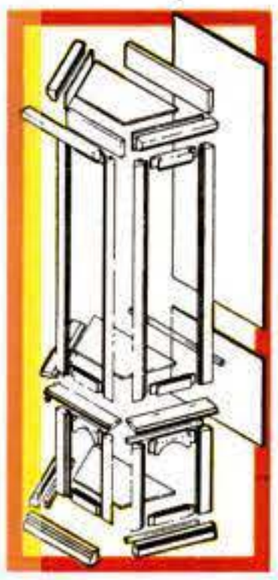

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Mars-watching

I was looking through your July 1971 issue and noticed an article entitled, "How You Can See the Biggest Show in the Solar System." It explained the retrograde movement of Mars and showed how to photograph it. It said this event occurs every two years, in summer.

Could you please tell me when this illusion will next appear?

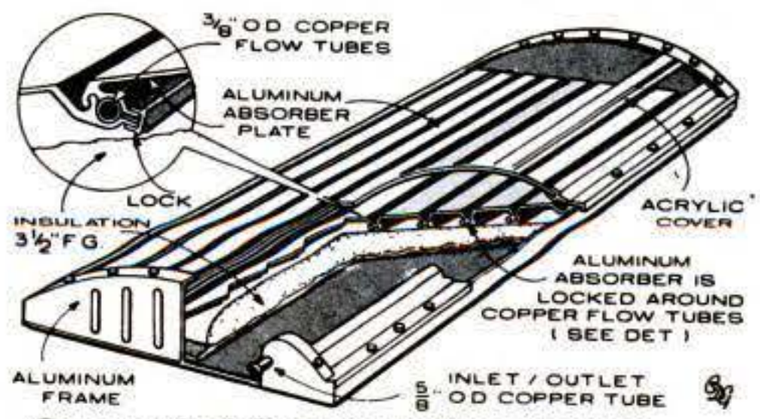
Chris White, Danville, Ill.

Dr. Sune Engelbrektson of Pace University supplies the following information: "The event does not always occur during the summer; it occurs approximately every 780 days. (But that's not exact because both the speed and orbit of Mars change.)

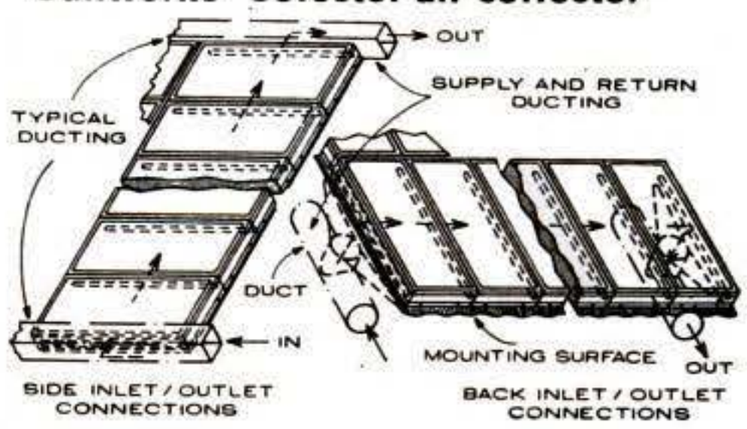
"Mars will next be in direct motion approaching stationary position on December 15, 1977, when the retrograde motion will begin. The planet will continue in retrograde through January, approaching its stationary point at the end of February '78, resuming its direct motion from west to east in March."

Correction: In some August issues of PS, two drawings of solar collectors in "PS Update: The Latest Solar-Heating Equipment" [p. 89] were transposed by the printer. The drawings, correctly identified, are shown here:

Grumman's Finplank liquid collector



Sunworks' Solector air collector



Gossamer Condor—prizewinner?

On August 23, just as this issue went to press, we learned that earlier in the day aviation history was made in Shafter, Calif., when Paul MacCready's man-powered aircraft, the Gossamer Condor (see page 122), successfully flew the Kremer Prize Course. Pedaled by 24-year-old Bryan Allen, an experienced cyclist and hang-glider pilot, the 70-pound plane completed the 1.4-mile figure-8 flight in seven minutes 22 seconds at an average speed of 10 mph. MacCready is claiming the $86,000 purse that has awaited a winner for 18 years.

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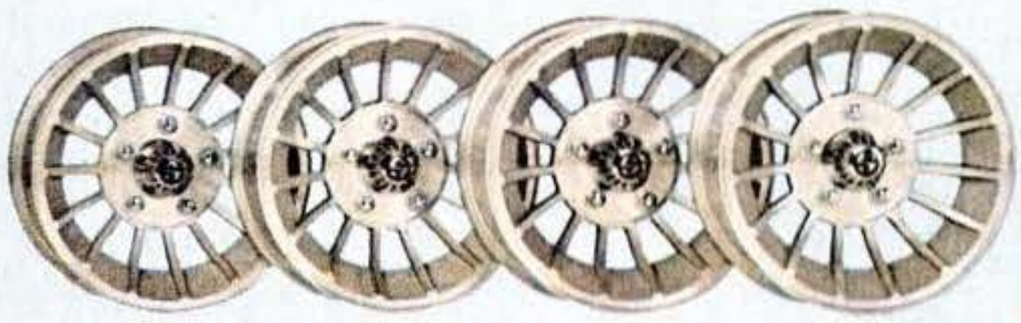

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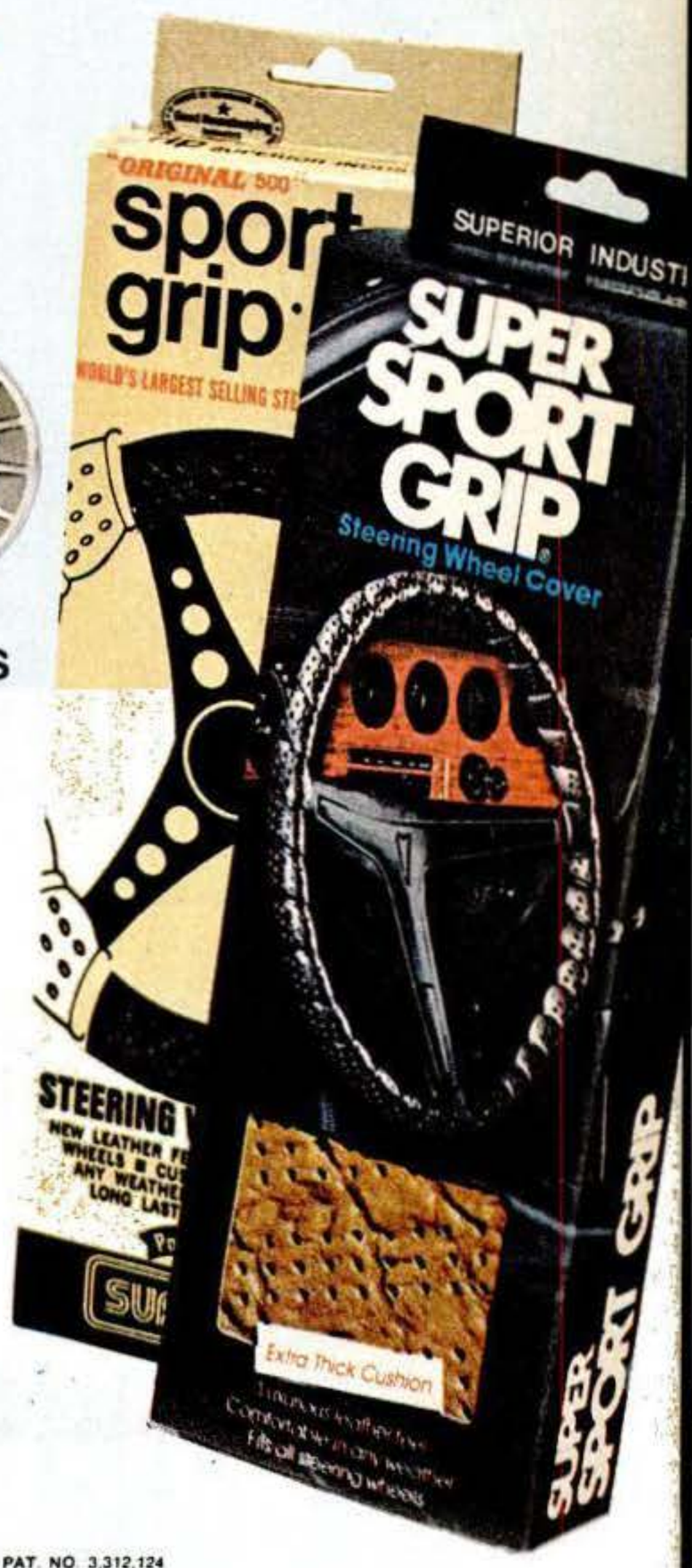

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The new sound of shirt-pocket tape recorders

They can take notes or dictation and even provide you with entertainment. But capstan or spindle drive makes a difference

By ROBERT GORMAN

There's more to the sometimes golden, sometimes tinny sound of today's micro- and minicassette tape recorders than meets the ear. I discovered that when I checked a broad sampling of the vest-pocket machines.

The recorders, which capture sound on matchbook-size cassettes only a quarter the size of the ones used in tape decks and most portables, perform surprisingly well. They're made with two basically different tape-transport systems: spindle drive and capstan drive.

Spindle drive

As you can see in the drawing later in this article, this system is inherently prone to tape-speed variation because the rate at which tape moves past the magnetic head is affected by the constantly changing diameter of the reel on which it is wound. In play and record modes, it's the take-up reel that does the winding. A pinion on the recorder's motor shaft drives a rotating spindle that engages the core of the reel. In rewind mode the pinion is tilted to engage the supply-reel spindle, which pulls the tape back as it turns.

Assuming constant motor and spindle rotation, actual tape speed across the recording playback head increases as wound-on tape increases the diameter of

Continued

Vest-pocket recorders make good traveling companions in a plane or wherever else you might need a convenient note-taker. Author Gorman checked specs and operations of a broad sampling, including the new Pearlcorder that he's holding (with a plug-in voice-actuated switch at the base that turned out to be too sensitive to background vibration for proper operation in a plane). Others, from left on arm table: Sony, Norelco, and Sankyo (each of these takes a different-size cassette); and, top row on seat, Grundig's 2010 and larger 2050 (which use still another cassette), J.C. Penney's, and the lookalike Westminster from Ward's. Second row: Dictaphone, Realistic, Panasonic, and Courterport B. Bottom: Two-speed Courterport, Compur-Hermes, Lanier, General Electric. Photo aboard L 1011 arranged for by TWA.

PHOTO BY MARK KOZLOWSKI

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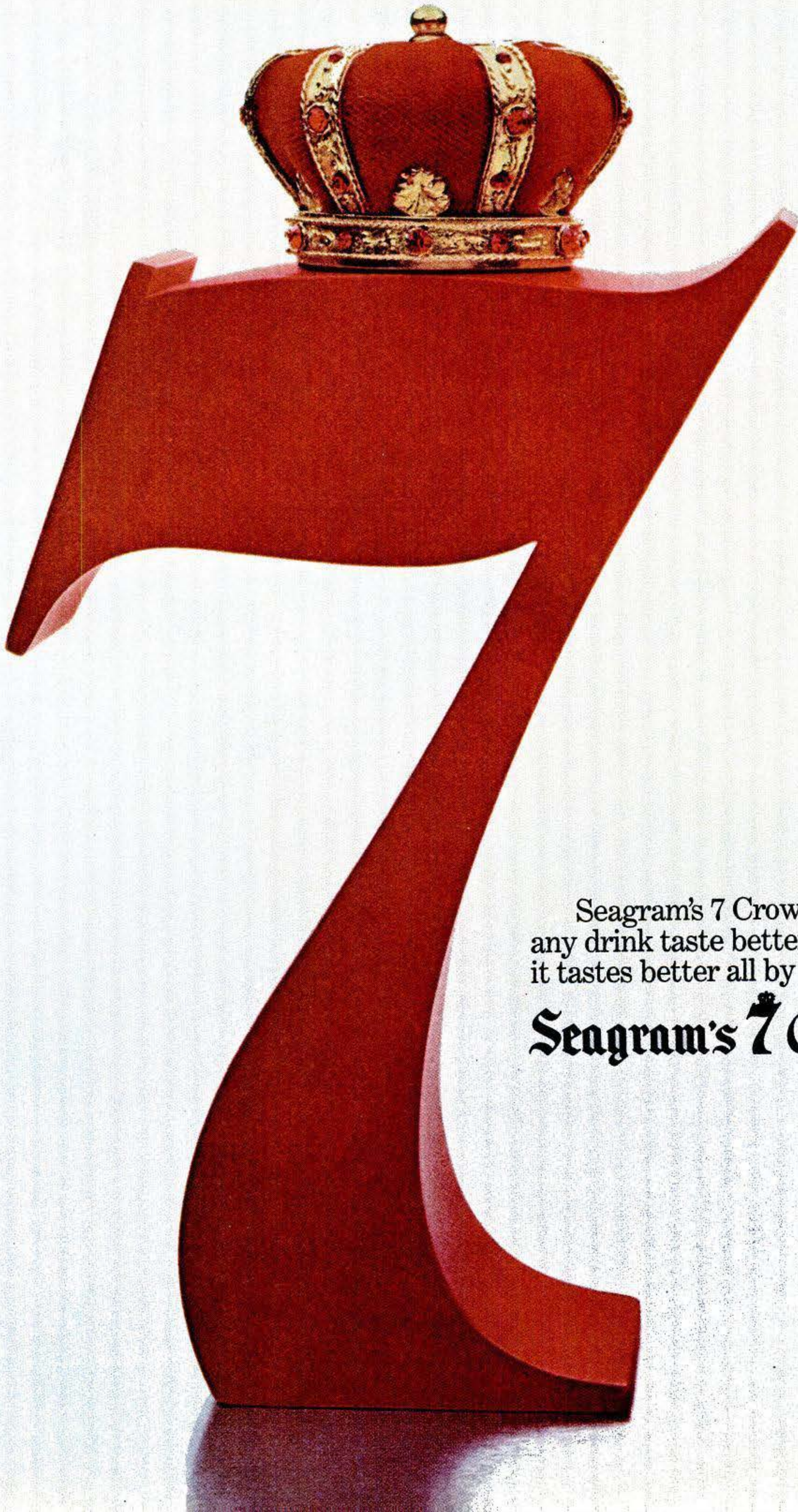

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The Black Max concept goes back to 1971, when Mercury engineers began development of a racing V-6. The basic powerhead now used in Black Max was initially developed for this engine. The racing version operates in the 8,000 to 9,000 rpm range and develops 250 horsepower.

On the rugged racing circuits, this engine proved its performance, dependability—and its durability—by winning 18 straight races.

ENGINEERING WITH A PURPOSE: PERFORMANCE PLUS DEPENDABILITY.

From this beginning, through six years of refining, testing and proving, the first production model of Black Max came into being.

Today there are three Black Max outboards, representing the

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highest standards of engineering excellence in performance, dependability and durability for long engine life.

60° V-6 ENGINE DESIGN: MORE POWER IN LESS SPACE.

The Black Max engines are exceptionally compact for V-6 engines in their horsepower range. We set the cylinder banks 60° apart instead of the usual 90°, resulting in an engine that is slimmer, lower and 36 pounds lighter than comparable V-6 outboards.

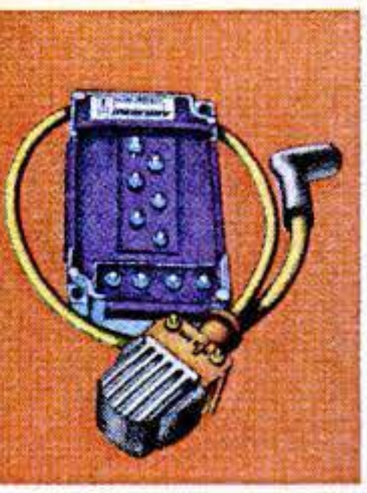
GREATER EFFICIENCY WITH LOOP CHARGING AND POWER-PORTED PISTONS.

Loop charging uses two opposing intake ports in the cylinder wall. The fuel/air mix, or "charge," collides and "loops" to fill the chamber.

At the same time, a third port in the piston itself pushes additional fuel/air mix into the chamber at right angles to the other ports.

The result is better engine performance utilizing the maximum charge of fuel/air mix. You get faster acceleration, more pulling power, and easy cruising on less fuel.

IGNITION TUNE-UPS ALL BUT ELIMINATED.

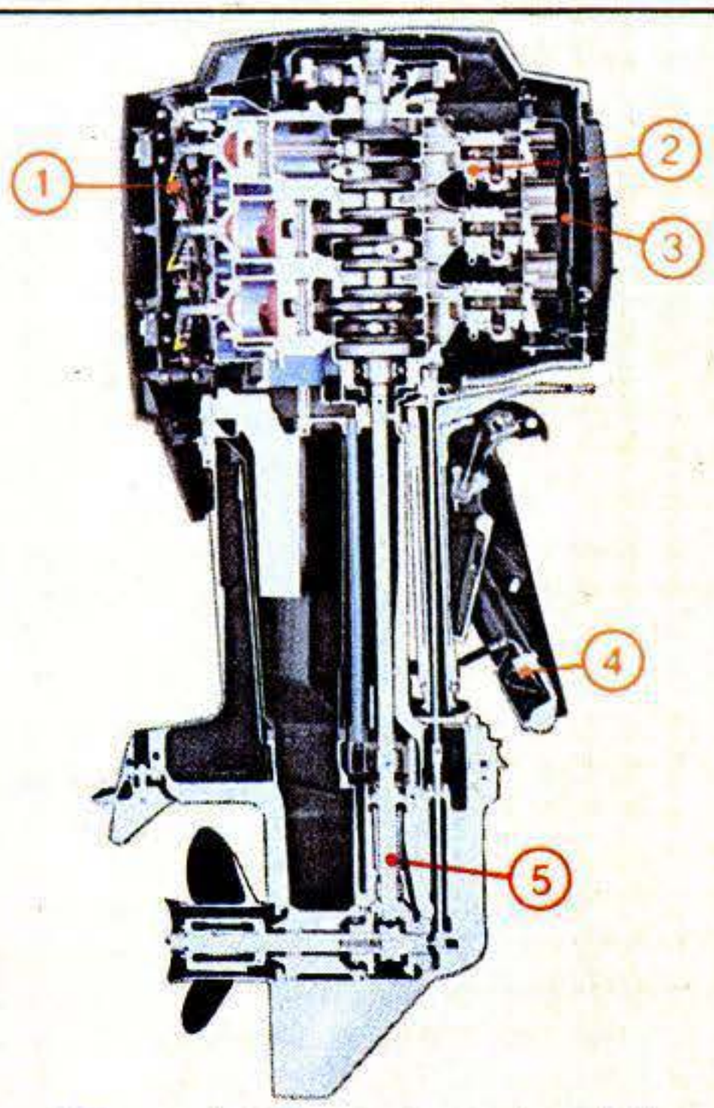


Thunderbolt® CD sealed ignition creates a spark so hot (up to 40,000 volts) it burns away combustion by-products. The Perma Gap® spark plugs have a short electrode positioned in the middle of a circular electrode.

So even if a bit of fouling should occur, the spark can fire hot and clean on any other part of the circle. And Perma Gap spark plugs last not just for months, but for seasons.

With Thunderbolt sealed ignition and Perma Gap plugs, you get quick starts and smooth running, and you spend more time on the water and less in the shop.

THE MEANEST, TOUGHEST MOST BEAUTIFUL MACHINE WE'VE EVER BUILT.



(1) Thunderbolt CD sealed ignition for reliability—separate coil for each cylinder—separate ignition system for each bank of cylinders—there's no distributor. (2) Three dual-throat carburetors for better fuel distribution—one barrel for each cylinder. (3) Computer-tuned air intake silencer for a quieter operating engine. (4) Built-in Power Trim adjusts boat attitude for greater efficiency, economy and smoother ride. (5) Stainless steel shift shaft, drive shaft and prop shaft to combat corrosion.

A BACK-UP SYSTEM TO KEEP YOU GOING: INDEPENDENT ELECTRONIC IGNITION SYSTEMS FOR EACH BANK OF CYLINDERS.

The Black Max V-6 engine has two banks of three cylinders. Each cylinder bank has its own independent ignition system, consisting of separate solid-state switch boxes, circuits, and coils. Should one system fail to operate, the engine will continue to run on the other bank, so you won't be stalled on the water.

REMARKABLE FUEL ECONOMY WITH THREE FIXED JET CARBURETORS.

The back-drag carburetor reduces fuel consumption up to 37% over conventional carburetors at cruising speeds. Fixed jets precisely meter the proper amount of fuel, without adjustment, over the entire rpm range.

The Black Max engines have three back-drag carburetors with dual barrels—one for each cylinder—for more efficient fuel distribution.

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MERCURY OUTBOARDS

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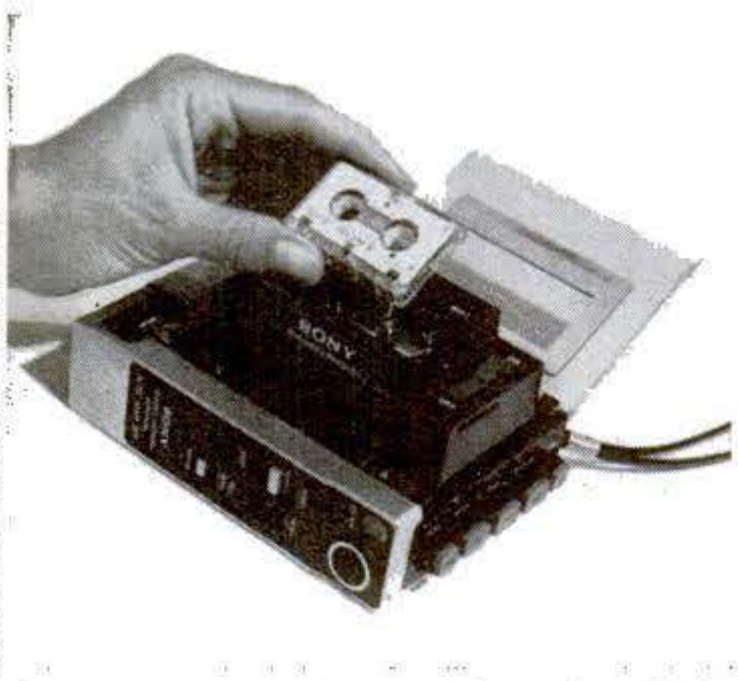

Smaller cassettes can be played in standard units by using Sony's adapter model MA-40. It works, however, only with capstan-drive cassettes. It's $89.

FM tuner can be added to Pearlcorder SD. It plays through recorder's speaker. It can also be used to make recordings off the air. Price of the tuner is $45.

the take-up reel. But while tape-speed variation is a dirty word in the lexicon of audiophiles, I found that it didn't cause much perceptible wow or distortion in my voice-only, low-fidelity tests. In most models, speed variation during recording corresponded closely with playback variation, canceling out their effects.

Somewhat to my surprise, I found a fairly high degree of drive-speed standardization from model to model, ranging, apparently, from 1.2 inches per second (ips) at the start of a tape to about 1.8 ips at the end. This resulted in fair voice intelligibility when I recorded a cassette on one machine and played it back on another.

This standardization, of sorts, is important for several reasons. In

Continued

PS BUYER'S GUIDE TO VEST-POCKET CASSETTE RECORDERS

Make and model	Price[1]	Size (inches HxWxD)	Weight (oz. incl. battery and cassette)	Power supply[2]	Fast-wind ratios: Rewind	Fast-wind ratios: Forward	Audible fast wind[3]: Review	Audible fast wind[3]: Cue	Record LED	Pause control	Sensitivity (ft.)[4]	Jacks	Comments
Compur-Hermes[5]	$130	6x2x1⅛	10	9V batt.[a]	4.5x	4.7x	No	Yes	No	No	2	Ear, mike, remote	Good off lock; microphone doubles as speaker
Courterport B	130	5½x2½x1⅜	14	9V batt. 2 AA batt.	12x	No	No	No	No	No	15	Ear	Half-speed spindle drive gives 30 minutes on regular 15-minute cassette
Courterport RAD7	400	5¼x2½x1⅛	12	2 AA batt.[a]	22x 11x	22x 11x	Yes	Yes	Yes	Yes	20 20	Ear, mike	Two-speed capstan drive gives one hour on regular 30-minute cassette. Top figure at 15/32 ips, lower at 15/16 ips
Dictaphone 10[5]	165	5x2½x1	10	9V batt.	10x	No	No	No	No	No	5	Ear, mike	Has EOT, no-tape signal; microphone doubles as speaker
General Electric Micro II 3-5330	75	5⅜x2½x1	10	9V batt.[a,c]	8.5x	3.3x	Yes	Yes	Yes	No	20	Ear, mike	Good off switch, EOT signal: rewind and fast forward in audible mode only
Grundig 2010[5]	180	4⅞x2¾x15/16	10	9V batt.[a,b]	15x	11x	No	No	Yes	Yes	2	Ear, mike	Uses special cassette; has visible elapsed-time index
Grundig 2050[5]	225	6½x2⅞x1⅜	14	3 AA batt.[a,b]	24x	24x	No	No	Yes	Yes	n.a.	Ear, mike	Uses special cassette; has visible time index, audible locator, no-tape and end-of-tape (EOT) signal
Janmor (Lafayette)	50	5½x2½x1½	14	9V batt. 2 AA batt.	6x	No	No	No	No	No	15	Ear	Lafayette price shown; same unit under this and other names available elsewhere at various prices
Lanier Microsette 60[5]	219	5½x2½x1⅛	13	2 AA batt.	10x	10x	Yes	Yes	Yes	Yes	20	Ear, mike	Good off lock; EOT signal
Norelco 185[5]	135	4¾x2⅝x1⅜	10	9V batt.	10x	No	No	No	Yes	Yes	15	Mike	Controls not marked; good off lock, EOT
Panasonic RQ 170S	130	5½x2½x1⅛	12	2 AA batt.[a,b]	11.5x	11.5x	Yes	Yes	Yes	Yes	25	Ear, mike	Lowest price of the Olympus-type high-quality units
Pearlcorder S	180	5¼x2½x1⅛	12	2 AA batt.[a]	11x	11x	Yes	Yes	Yes	Yes	20	Ear, mike	Automatic EOT shutoff
Pearlcorder SD	240	5½x2⅝x15/16	12	2 AA batt.[a,b,c]	13x	11x	Yes	Yes	Yes	Yes	30	Ear, mike	Tape eject, EOT shutoff; wide range of attachments available
J.C. Penney 6505A	40	5½x2½x1⅜	13	3 AA batt.	4x	No	No	No	No	No	10	Ear, remote	Lowest price of well-made spindle-drive units
Realistic 14-814 (Radio Shack)	60	5 3/16x2¾x15/16	12	9V batt.[a,c]	8.5x	No	No	No	No	No	15	Ear, mike	LED lights for low-battery only. Good controls
Sankyo MTC 10	130	5⅜x2¾x1 3/32	12	2 AA batt.[a]	10x	7.5x	Yes	Yes	Yes	Yes	25-15[6]	Ear, mike	Uses special cassette; has noise-filter switch
Sony M-101	200	5 11/16x2 9/16x1 1/16	13	2 AA batt.[a,b]	24x	27x	Yes	Yes	Yes	No	20	Ear, mike	Good off lock
Webcor	60	4x2x1	12	2 AA batt.[a]	10x	1.5x	Yes	No	Yes	No	n.a.	Ear, mike	EOT signal
Westminster (Montgomery Ward 3977)	59	5½x2½x1½	14	9V batt. 2 AA batt.	6x	No	No	No	No	No	15	Ear	

Units in tinted rows have capstan drive; others are spindle-driven.
n.a.—working model not available for this test.
[1]Prices are manufacturers' suggested retail or mail-order catalog. Noncatalog units are sold in department, electronic, camera, and other stores and may be discounted in many areas. See footnote 5, below.

[2]"a" indicates AC adaptor available (included with Pearlcorder SD and Panasonic RQ-170S); "b" indicates rechargeable battery pack available; "c" indicates car adapter available.

[3]Sound can be switched on in some models during rewind or fast forward as a cueing aid for locating recorded segments. Usually audible rewind (review) is slower than silent rewind and audible forward (cue) slower than silent fast forward.

[4]This is the approximate maximum distance at which normal speech, recorded in a relatively quiet place, could be played back intelligibly. This is a subjective test and distances represent the author's judgment. Battery condition affected results.

[5]These units are marketed primarily as components in integrated office systems. Desk-top transcribers for spindle-drive cassettes have speed adjustments and may amplify recorded sound. Units are designed to suppress background noise in close-up dictation; for distant or conference use most require external microphones, so distance-sensitivity measurement may not be significant. Most of these units are sold by office-supply dealers or company representatives, usually at the price shown.

[6]Switching the Sankyo noise filter to "on" seemed to reduce distance-sensitivity from about 25 feet to 15 feet.

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systems designed primarily for business use (more about this later), typists should have little trouble in understanding dictation when they play back cassettes on speed-adjustable transcribers. But even without special equipment, spindle-drive cassettes should normally work well for mailed-tape correspondence even when machines at opposite ends are not of the same make.

More importantly, relatively good speed standardization means that you can depend on getting close to 15 minutes of recording time on each side of any Norelco-type cassette under whatever brand name you buy it. (See the box above for a full description of Norelco-type and Olympus-type cassettes.)

A couple of recently introduced cassettes (GE, Certron) built to the Norelco configuration play 20 minutes per side on thinner stock. They're clearly labeled, however, so you should have no trouble distinguishing them. The one exception to the 15- (or 20-) minute playing time I came across is in the geared-down Courterport B (see table). It drives the tape at about half-normal spindle speed for double playing time on any Norelco-type cassette. To my surprise, I found that clarity and intelligibility were quite comparable to normal-speed machines of this type and that distance and sensitivity were equal to or better than on most others. My machine, incidentally, works at half speed only, but I was told that a switchable full- and half-speed model will soon be available at the same price.

Spindle-drive cassettes are intended for speech-only recording where fidelity isn't important. One quality limitation arises from the fact that tape-to-head contact is maintained strictly by tape tension, and this must be held down to avoid overrunning, binding, or excessive motor drain. Moreover, the mechanical simplicity of this system is usually matched by electronic corner-cutting that aims toward the lower end of the vest-pocket recorders. In the spindle-drive group, it seems to be accomplished mostly be setting the recording level close to tape saturation. This form of automatic level control helps to suppress some background noise when you speak directly into the microphone, but its effectiveness varies and is not particularly good in any unit I tried. Playback volume seemed low to me in most models (with GE best in this respect and the Realistic close behind). In sum, I wouldn't be happy with any of the spindle-driven machines for recording in a noisy place or more than about 10 feet from a sound source.

If you're thinking of putting a vest-pocket recorder to more varied —and maybe some fun—uses, you should look at the other basic type, featuring capstan drive.

Micro? Mini? Micro-Mini?

Compact, battery-powered recorders that play standard-size cassettes are called minirecorders, so the term micro is used to distinguish the still-smaller ones that use matchbook-size cassettes. These, however, are not all alike.

The most common cassette configuration, the Norelco, uses a spindle-drive system. All the spindle-drive recorders listed in our table take the Norelco-type cassette. Norelco calls this cassette a mini; others call it a micro.

The other main cassette type is the Olympus, which has registered the trade name Microcassette to describe it. It fits all the capstan-drive machines in the table except the Sankyo ("micro-mini") and the two Grundigs ("mini"), each of which takes only its own special cassette.

Size isn't a big factor in the micro vs. mini mixup. The Norelco-type cassette measures 2¼" by 1⅜" by 5/16"; the Olympus-type is 2" by 1-5/16" by 5/16". Dimensions of the two noninterchangeable cassettes are very close. The Sankyo measures 2⅛" by 1⅜"; Dejur Grundig's is 2½" by 1¾" by ⅜".

Capstan drive

All the recorders in color blocks in the chart employ a capstan-drive system; most are designed to play the Olympus-type Microcassette, a registered trademark.

A rotating, flywheel-regulated capstan moves the tape at a constant speed regardless of how much is wound on either the supply or take-up reel. When a mechanically advanced pinch roller presses the tape against the spinning capstan, the tape moves forward in close contact with the magnetic head at a uniform 15/16 ips. At this speed the Sankyo and all the Olympus-type cassettes (available in many brands) play for 30 minutes on one side only.

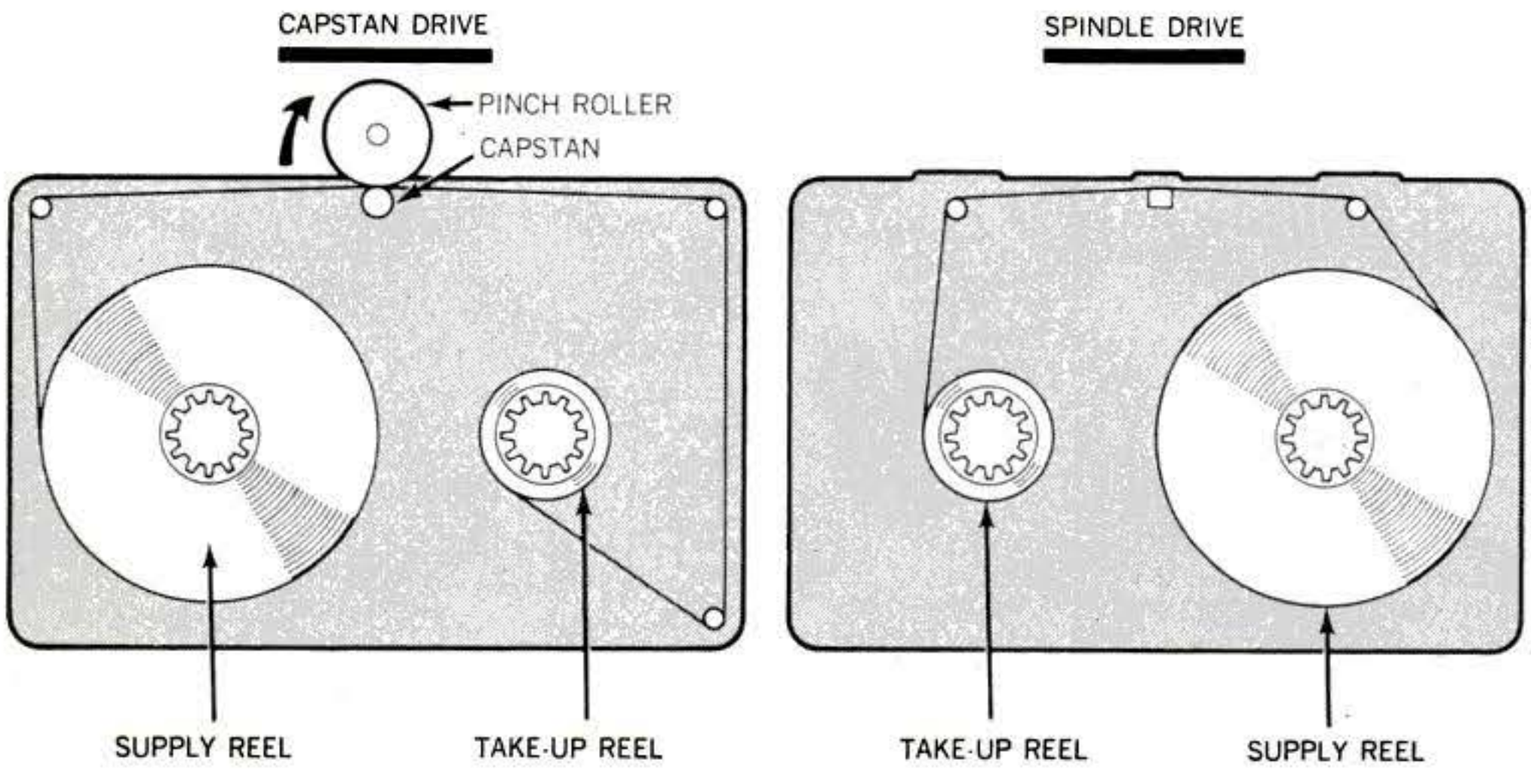
As we go to press, Pearlcorder has introduced its new Model S-301 ($200), a two-speed recorder that can be switched down to 15/32 ips for double playing time on a regular Olympus-type cassette. Panasonic also announced a two-speed model.

I tested an apparently similar unit (actually a modified Pearlcorder S) being marketed here by Courterport, and found voice quality quite good at this tape-saving speed. In fact, even some strong-beat music came through rather acceptably when I patched it from an FM broadcast, bypassing the recorder's microphone.

Courterport, incidentally, has also introduced an Olympus-type cassette using thinner tape stock. It worked well, with a somewhat softer, but quite clear tone, on several compatible machines on which I used it. Recording time was about 45 minutes per side at 15/16 ips, twice that at 15/32 ips.

Borrowed directly from larger decks and recorders, the capstan-

[*Continued on page 184*]



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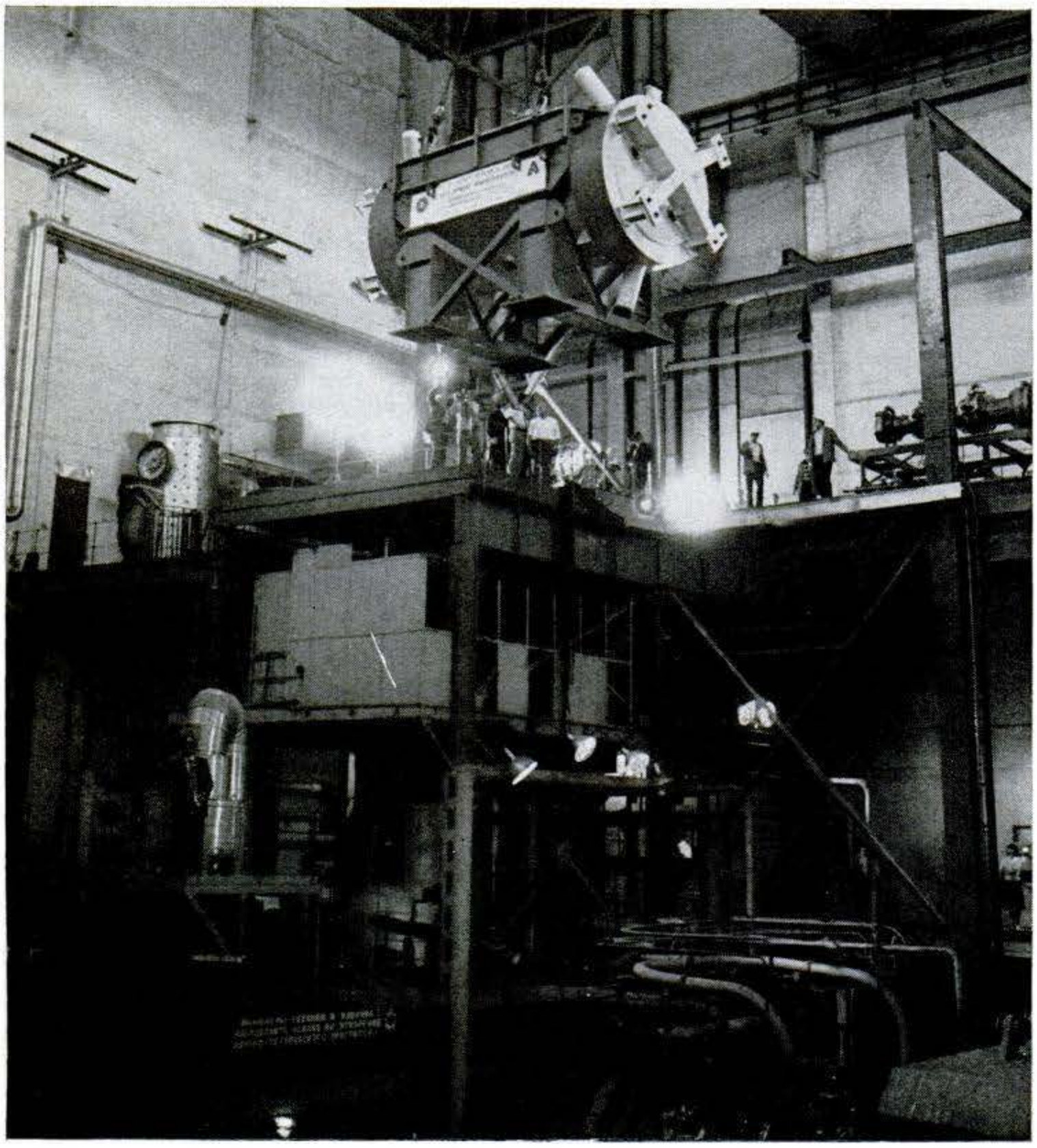
SCIENCE NEWSFRONT

BY ARTHUR FISHER



US + USSR = MHD

That's a giant U.S.-built superconducting magnet being installed (above) at a research facility outside Moscow. Why? It's part of a joint program to develop the energy technology known as MHD (short for magnetohydrodynamics), a method that promises a cheaper and more efficient way to convert our bountiful coal reserves into electricity [PS, June '69; March '74]. Huge superconducting magnets are an essential ingredient in advanced MHD systems; this one weighs 40 tons and was airlifted to Russia on a U.S. Air Force C-5 Galaxy, the world's largest aircraft. It's been installed at the U-25 power plant, which, operated by the USSR Institute for High Temperatures, is the world's largest MHD facility.

The magnet was designed and built by ERDA's Argonne National Laboratory near Chicago. Dr. William D. Jackson, ERDA's Director of MHD, called the joint project "the most significant event in Soviet-American scientific cooperation since the Apollo-Soyuz space flight."

The Soviets have pursued the goal of a successful MHD technology far more vigorously than we have; they've spent about 10 times as much on MHD over the last 15 years. In fact, the U.S. does not possess an MHD test facility able to use magnets of this size; ERDA is now building one at Butte, Montana, but it will not be finished for another three years.

E-beam fusion

There's been another step forward—an important one—in our fusion program. For the first time in the U.S., physicists have managed to generate neutrons from a thermonuclear fusion reaction in a fuel pellet compressed by high-power beams of electrons [see "Laser Fusion," PS, Dec. '76]. In the experiment, at ERDA's Sandia Laboratories in Albuquerque, N.M., a BB-size deuterium-filled pellet absorbed about 40 billion watts of power from a 10-millionth-second e-beam pulse, was compressed about a thousandfold, reached temperatures between five and 10 million degrees C, and released about a million neutrons.

Penetrating study

In another project at Sandia Labs, scientists have finished preliminary testing of a device that may help penetrate—literally—the mysteries of Mars. Shown in the photo (below, left), it is an instrumented penetrator that could be dropped from an orbiting spacecraft and pierce the Martian surface; then it would report back on subsurface conditions. The penetrator pictured was actually dropped at Amboy Crater, Amboy, Calif., where the ground—loam and sand-covered lava—most closely resembles what scientists anticipate on the Martian surface.

Sandia Labs has been experimenting with high-speed Earth penetrators for

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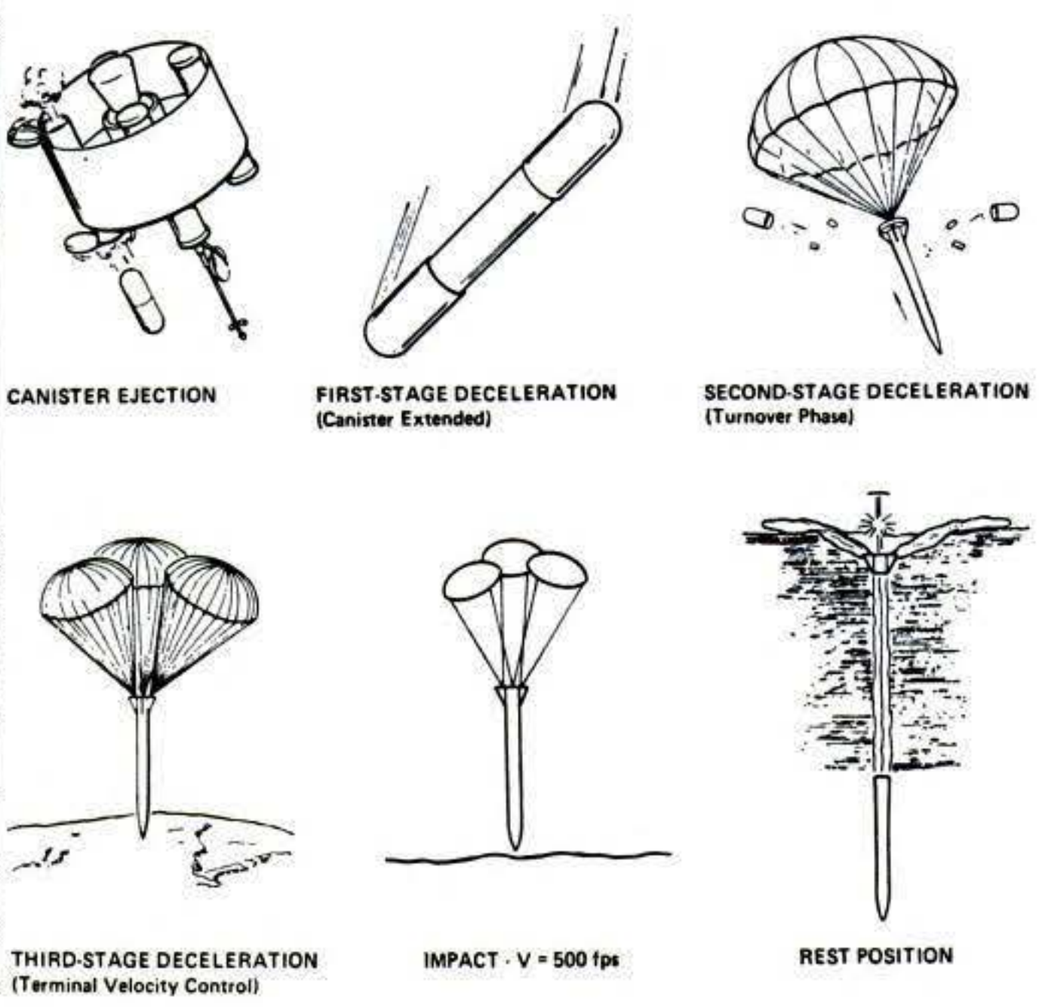

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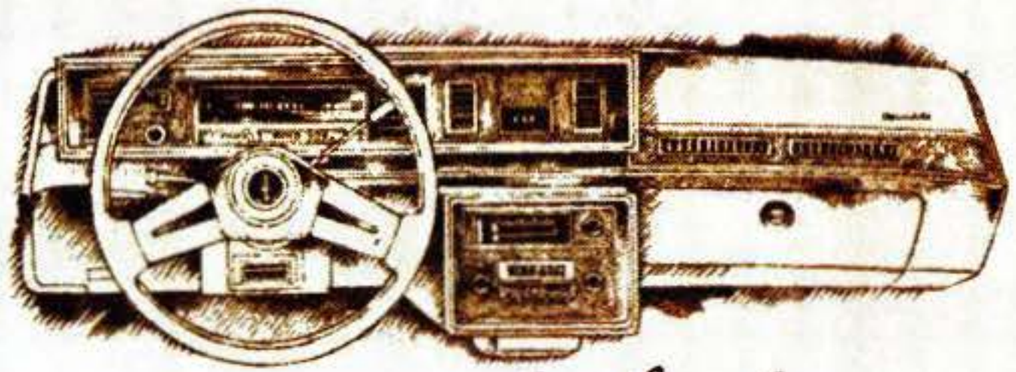
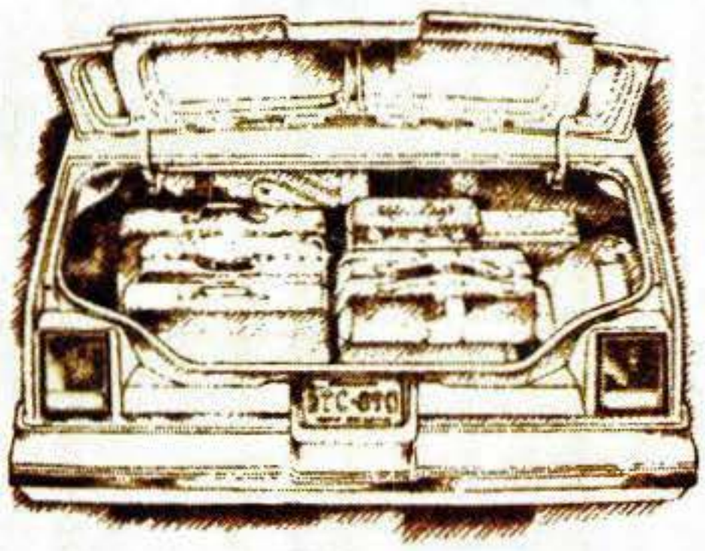
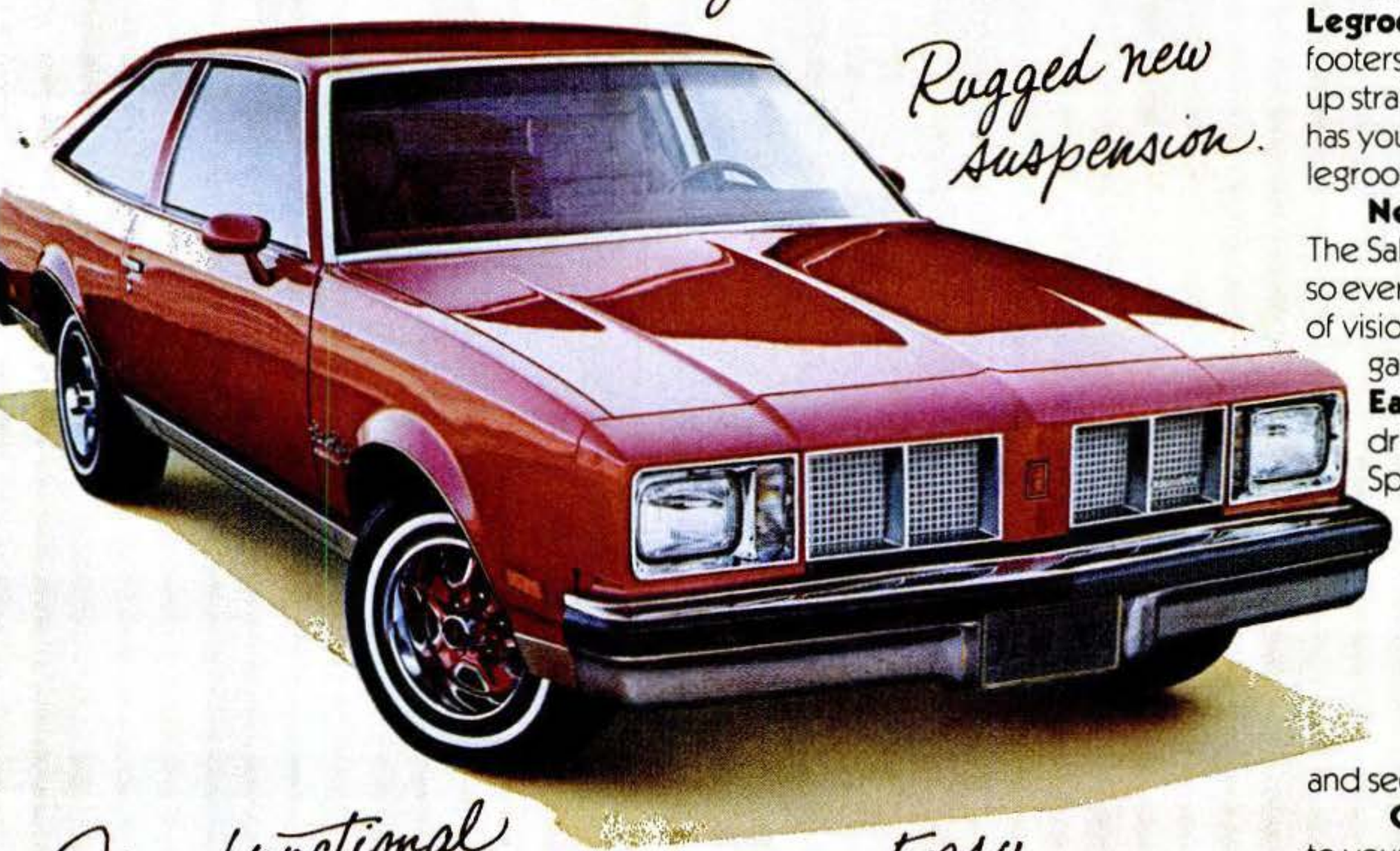


All new bi-level instrument panel.

Space efficient trunk.



Plenty of headroom and legroom.



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New functional design

Easy to park.

Did you ever have a good idea? So good you couldn't wait to tell someone about it? Well that's the way Olds feels about their new Cutlass Salon. Only it's more than just one idea. It's a carfull of them and they all add up to a shining example of what a re-styled car can do.

Plenty of Headroom and Legroom—Good news for six footers. Stretch out your legs, sit up straight and you'll notice Salon has your kind of headroom and legroom.

New Instrument Panel—The Salon's dash is neatly arranged so everything falls within your frame of vision. No hard-to-locate dials or gages.

Easy Parking—When you test drive the Salon, try parking it. Spaces you used to pass up now seem larger.

Impressive Feel-For-The-Road—Salon's trim body style and sophisticated suspension add up to a responsive, exciting road machine. Try it on your favorite road and see what we mean.

One more idea—Go down to your Olds dealer and take the Salon for a test drive. And discover that great Cutlass feeling. Spending a few minutes with so many ideas just might spark a few of your own.

Note: The Cutlass Salon is equipped with GM-built engines produced by various divisions. (See your dealer for details.)

CUTLASS SALON

Oldsmobile

Can we build one for you?

GM

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[*Continued*]

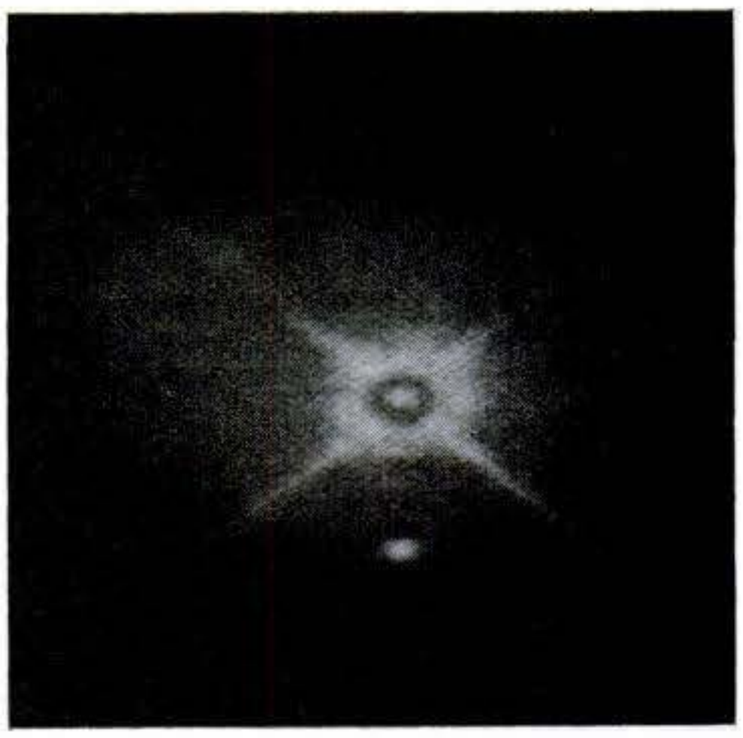
some 20 years, for a variety of applications. Thousands of them have been dropped or fired into water, ice, sand, mud, permafrost, clay, granite, and so on, for both weapons and geological studies, with depths of more than 200 feet sometimes achieved.

The penetrators, four feet long and 3½ inches wide, would be used as part of a geology-oriented mission to Mars in 1984. They would be hurled from a spacecraft in orbit, and then aerodynamically decelerated, with a final descent by parachute (see drawing, previous page). They would hit the surface at about 500 feet per second and plunge beneath it to a depth of perhaps 45 feet.

The two-year development program at Sandia was paid for by NASA's Ames Research Center.

Supergiant star

One of the most familiar of all the stars in the sky—the red giant Betelgeuse in the constellation of Orion—may actually be a supergiant some 400 times larger than our entire solar system. Evidence for this startling theory comes from the remarkable photo shown here. Taken with a unique TV camera tube that is sensitive to near-infrared light and can

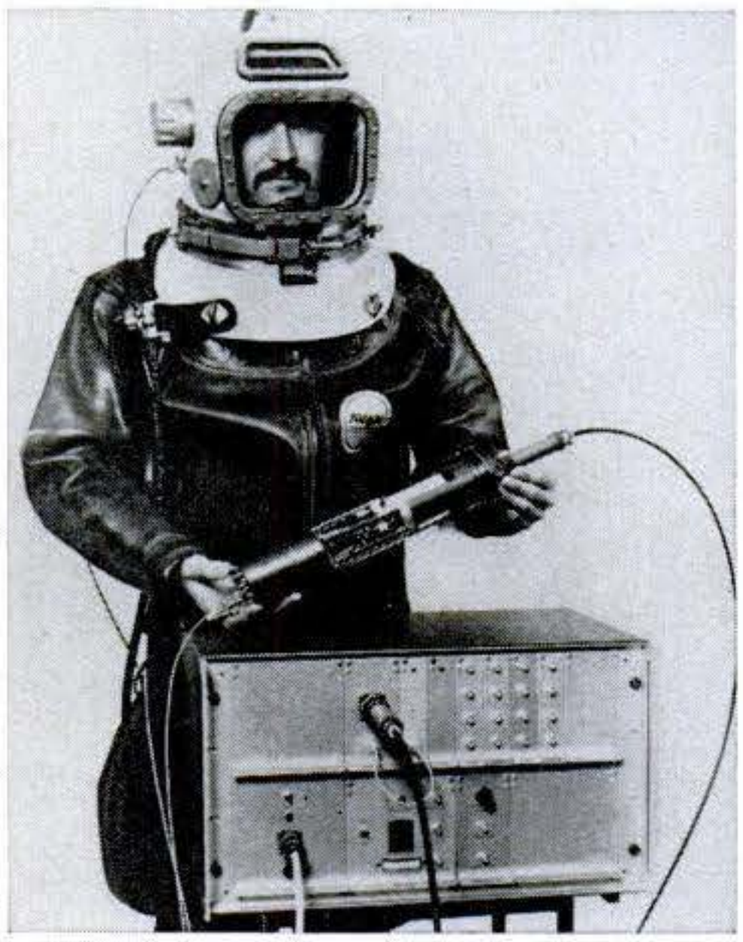


electronically intensify very faint images, the picture reveals Betelgeuse (bright center image) surrounded by a shell of matter that is at least 400 times larger than the seven-billion-mile orbit of Pluto around the sun. It had been known before that the red giants lose matter into space, but this photo for the first time gives evidence of a truly enormous rate of loss.

The equipment used to take and process the picture was developed at the Los Alamos Scientific Laboratory in Los Alamos, N.M.

Diver fiber optics

Prospecting for offshore oil and other valuables on the continental shelf has meant a boom for deep-sea divers. It has also created additional concerns about the safety and efficient performance of these risk-taking specialists. Now International Telephone and Telegraph Corp., through British and U.S. subsidiaries, has introduced sophisti-



cated fiber-optics communications systems that allow surface-based observers to monitor the status of a diver on the sea floor through a single slender, lightweight cable of glass threads. The system provides voice communications, checks the diver's physical condition, and can even display TV pictures of him on the bottom. PS

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Look for Prowler's new beige and brown exterior. You'll be seeing a lot of them on the road.

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THE PLATTER IS THE MOTOR.

Fisher introduces a major advance in audio technology: the linear motor 120 pole, direct drive turntable.

One of the problems in improving direct drive turntable performance is reducing wow & flutter due to cogging action of the motor.

With its limited number of poles (usually 12) and its relatively slow operating speed, most conventional direct drive systems also have an inherent problem of low starting torque.

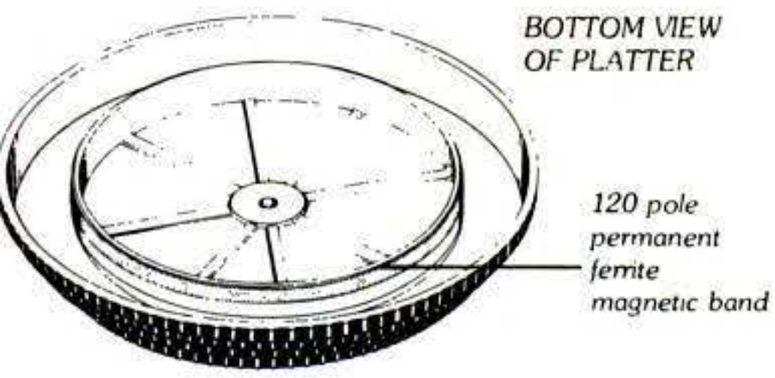
To solve these problems, Fisher has engineered the linear motor, direct drive system. The new Fisher MT6225.

In effect, the platter becomes the turntable's motor. And Fisher's 120 pole design practically eliminates cogging action, and lowers wow & flutter to a totally inaudible 0.03%.

The linear motor direct drive system further reduces turntable rumble to an extremely low −70 dB, far below hearing level.

HOW IT WORKS

A continuous band of ferrite material, containing 120 magnetic poles, is attached to the inside bottom rim of the platter. To start platter rotation, each pole opposes one of the electromagnetic drivers on the base top. Each of the 120 poles is attracted or repelled as it passes the driving electromagnets for smooth, stable operation.



An electronic sensing device monitors the platter's speed, and acts as a servo-feedback control to maintain practically perfect speed accuracy. Built-in strobe and pitch controls are provided.

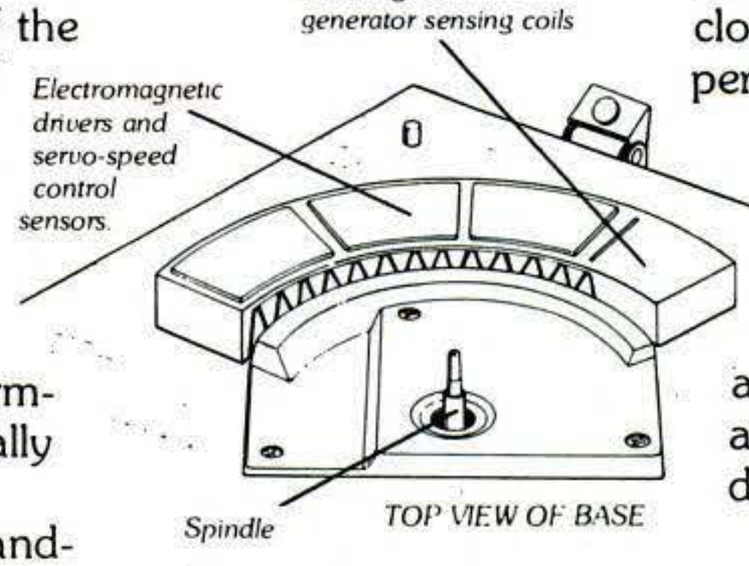
The speed accuracy of the system is independent of line voltage fluctuations.

THE ARM

The Fisher MT6225 is equipped with a professional-type gimbaled tone arm for performance to equal its technically advanced motor design.

The arm accepts all standard cartridges. The auto-return system, which returns the arm to rest at end of a record, is designed with no restraints on its lateral or vertical motion during operation.

The arm has adjustable tracking force with calibrated settings from 0.6 to 3.5 grams. There's also precise variable anti-skate, and viscous damped cueing. The MT6225 also has a heavy cast-aluminum platter, and a massive integrated base to absorb vibration.



In all, there is no other turntable available that comes closer to the perfect performance . . . or the ultimate in reliability. Fisher MT6225, for about $250.+ See it now at fine audio stores and the audio section of department stores.

Motor	Linear Direct Drive
Wow & Flutter	0.03% WRMS
Tracking Force Range	0.6 – 3.5 grams
Rumble	−70 dB (DIN B)
Maximum Tracking Error	± 1.5°
Auto Stop	Yes
Auto Reject	Yes
Cueing	Viscous Damped
Anti-Skate Control	Adjustable
Platter Weight	2.2 lbs.
Speed Selector	33/45 rpm

FISHER

The first name in high fidelity

Fisher Corporation,
21314 Lassen St.,
Chatsworth, Calif. 91311

MT6225

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+Manufacturer's suggested retail price. Actual selling price determined by individual dealer.

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THROUGH THE VIEWFINDER

By EVERETT H. ORTNER

Automatic box

The fancy electronics that make a modern single-lens-reflex camera automatic don't have to be built in, as the new Vivitar XC-3 with the box on top demonstrates. They can be an add-on. The XC-3 is a manually operated 35mm SLR with electronically controlled shutter speeds from four seconds to 1/1000 and an LED readout to indicate exposure. Want automatic exposure control? Slip the XC-A accessory into the camera's hot shoe and plug its cord into an outlet at the camera's front. The XC-A supplies aperture-preferred exposure (you select the lens opening; it sets the shutter speed from 1/8 to 1/1000 sec.).

What's the advantage of having that automatic-exposure box on top? Well, none that I can think of. But it does give the camera's distributor, Vivitar, an automatic-exposure model to sell when the distributorship of its star 35's, the Olympus OM-1 and OM-2, ends.

With a 50mm f/1.7 lens, the XC-3 lists for $269.95. The XC-A auto-control accessory is $49.95.

Color shift

Don't buy color film in that hot little gift shop somewhere between Spring Lake and Ocean Grove, N.J. I did last year when I ran out of film while photographing the wonderful Victorian buildings in those towns. I was dubious when I bought the film. The shop was un-air-conditioned; the lady took the film out of a case on the wall that was bathed in sunlight; I had the impression that she sold very little film; I didn't even check the film expiration date. At any rate, my slides came back with a green tinge—a color shift that probably resulted from dated or badly stored film.

It's rare in these air-conditioned days to buy badly stored film. Most storage sins are committed by us photographers: We buy more film than we need for one vacation and hold it for the next. We shoot part of a roll of film and leave it in the camera until the next occasion. We store our films in hot closets and car trunks.

We all know not to do those things. But what should you do if you have a lot of film that you won't use for a long time? Here are some facts to help you decide:

- The color balance of film keeps changing from the moment it's manufactured until it's processed.
- Most color film—the kind most of us use—is slightly "immature" when it's made. The manufacturer takes into account the time it takes to get the film from factory to you, and designs his film so that it will be at its best color balance—the "aim point," it's called—in the period from purchase to expiration date, the date on the film carton.
- Badly stored film (heat and humidity) shifts faster, and may yield inferior results before the expiration date.
- Film stored in the freezer will show almost imperceptible color shifts. Indeed, many professional photographers freeze large quantities of color film, all from one batch, to insure specific color characteristics.

Now the questions:

Why shouldn't you store color films like Kodachrome in the freezer? These days, Kodak is less than enthusiastic about that idea because it may prevent the film you buy from "maturing" properly. Suppose you bought the film early in its life; freezing it might prevent its ever reaching optimum color balance.

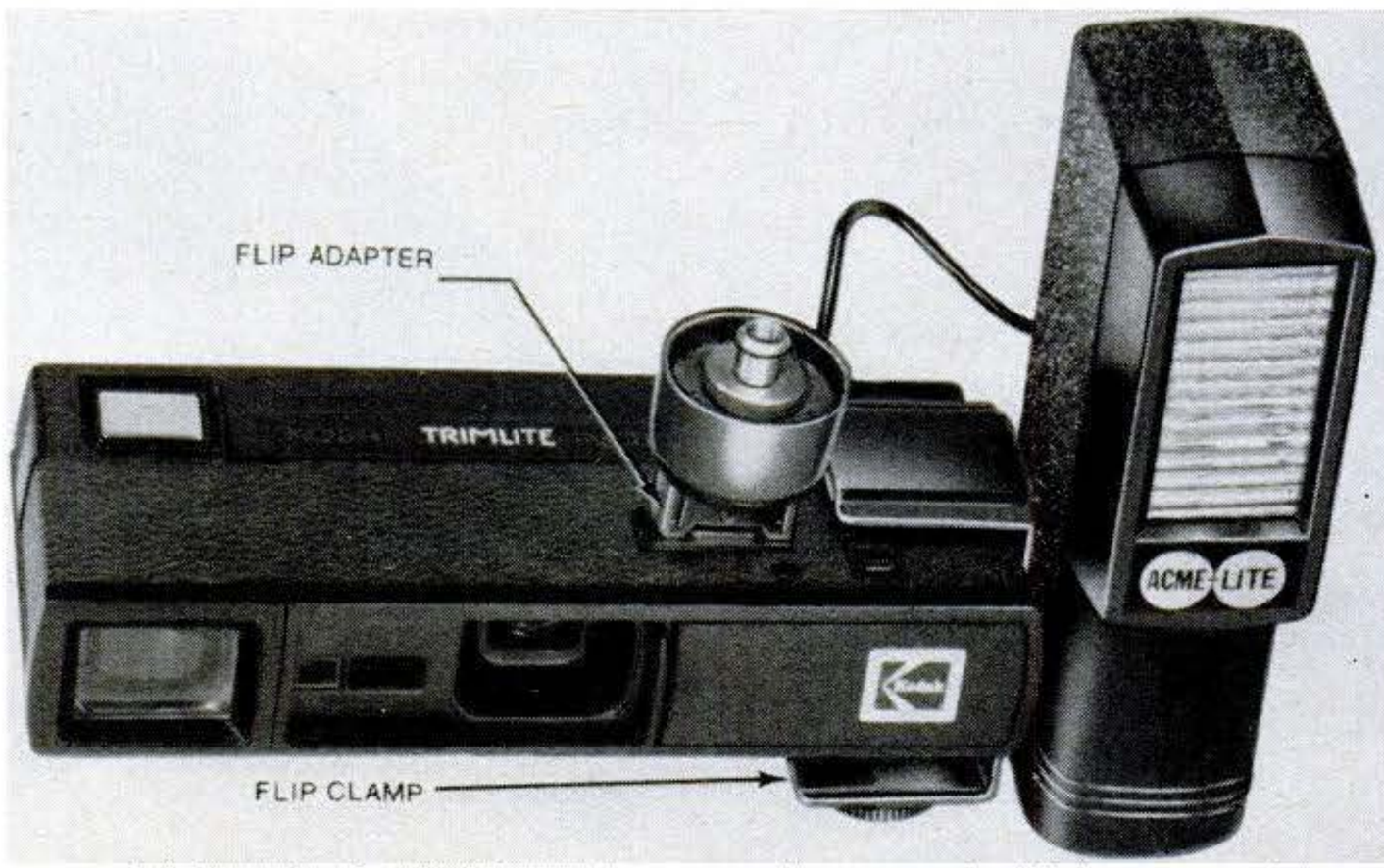
Then why not freeze the film at exactly its optimum color balance? That might work—but how would you know when the film had reached its optimum balance? And could you be sure that you were not freezing immature film, and thus defeating your aims?

Is there a way to be certain when you buy color film that it is at its optimum balance? Yes, if you buy the so-called "professional" films, like the professional Ektachromes or Vericolors. These are at the desired color balance at the time of release. But they must be refrigerated throughout their lives—during warehousing, shipping, storage by the customer, and even, if there is an appreciable delay, between exposure and processing.

I'm embarrassed to say, after all this, that I store all my film in the refrigerator—professional, amateur, even black-and-white. I suppose it's wrong, but on the other hand I have used some film far beyond its expiration date, and it worked fine.

Double flip

It's nice to see somebody simplifying life for the photographer instead of complicating it. Award of the month for ingenious simplification should go to the Acme-Lite Mfg. Co. (4646 Fulton St., Chicago, Ill. 60644). Take a look at Acme-Lite's model 138 electronic flash for Instamatic cameras. The Flip Adapter that plugs into the camera can turn either way: One end's for cameras designed for flipflash; the other end fits Magicube sockets. The Flip Clamp is also ingenious. Swiveled one way, it clamps to 110 cameras; the other way, to 126 cameras. Price: $24.95. PS



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The Minolta XL-660 sound movie camera gives you seven more features than the similarly priced Kodak®. Why do we do it?

If you're like most people, when you think of buying a movie camera, you think of buying a Kodak®.

So to change your mind, we at Minolta have to offer you *more* camera than you get from Kodak for about the same amount of money. Which is what we've done for you with the very versatile Minolta XL-660 super-8 sound movie camera.

That's why you get seven additional features for easier-to-take, more professional-looking movies. And it's a unique combination of features you can't get in a Kodak sound movie camera, no matter how much you pay. Here they are:

1. *Viewing through the lens that's taking the picture.* With the XL-660, you see exactly what the film sees all the time. So you're not likely to cut off people's heads.

2. *Close-ups right up to the front of the lens.* The XL-660 gives you magnificent close-ups of objects as small as flowers and coins. Great for interesting titles—using postcards, for instance.

3. *Professionally smooth power zooms from 7.5mm wide-angle to 45mm telephoto.* That's a 6-to-1 zoom range. Push one button to zoom in or out. Automatically.

4. *Automatic fade-in and fade-out of both picture and sound.* Another feature that contributes to professional-looking movies. On the Minolta you just push a button.

5. *Sound recording up to 50 feet away without wires between camera and subject* with the XL-660's FM wireless mike kit.*

6. *Recording from a second microphone, phonograph, tape recorder or TV directly onto your soundtrack.* A special attachment* lets you mix sounds from two sources.

7. *Boom or zoom mikes to capture far-away sounds.* The XL-660 system has two special-purpose microphones: A zoom mike* that can be removed from the camera and used handheld. And a boom mike* to follow distant sounds.

To be completely convinced, compare the Minolta XL-660 and the similarly priced Kodak side by side at your photo dealer. Or write for literature to Minolta Corporation, 101 Williams Drive, Ramsey, N.J. 07446.

*Optional, extra-cost accessory.
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Look how much more you get with a

MINOLTA

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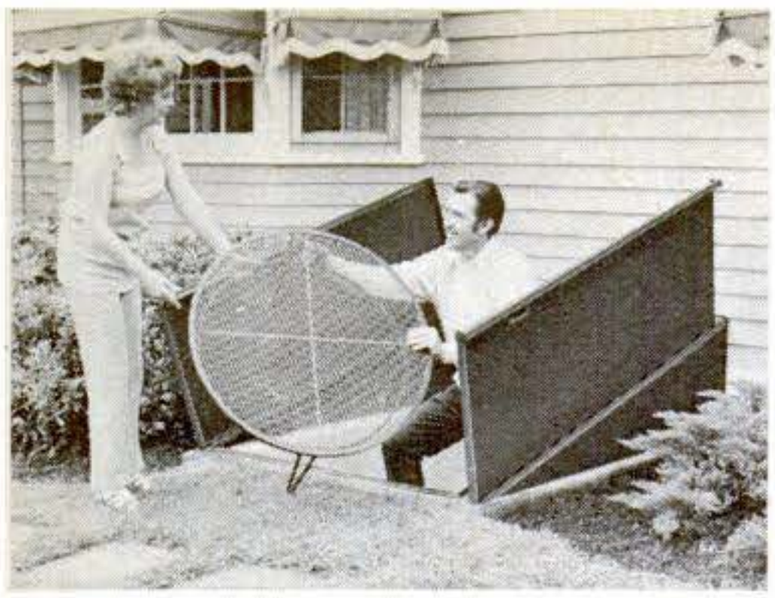
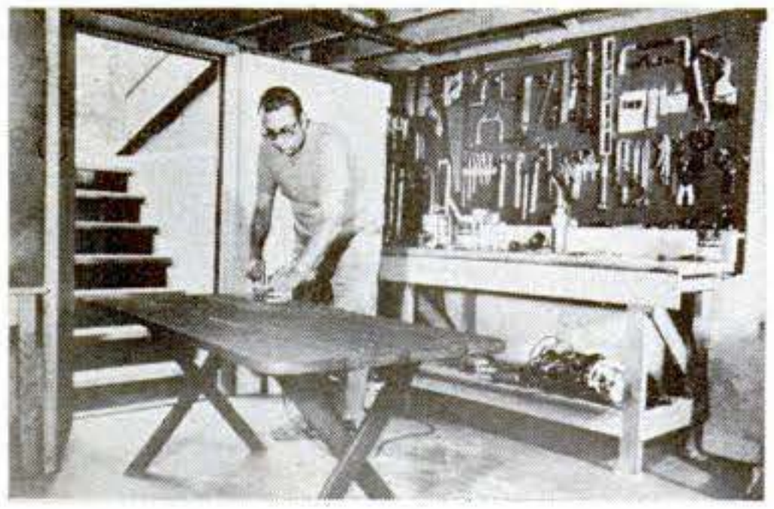


Enjoy your home more...



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You'll like the neat, trim appearance and rugged construction of a BILCO Door. It's easy to operate, watertight and made of heavy gauge steel for lasting service.

As a replacement for your worn out, troublesome wooden door, a modern BILCO Door will add new beauty to your home. And it will pay for itself in savings on repair and replacement costs.

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Please send me:

- ☐ Information for replacing a wooden door.
- ☐ "How-To" booklet for adding outside entrance to present home.
- ☐ Data for new home to be built.

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Address_____

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State_____ Zip_____

"SAY, SMOKEY—"

A clinic on cars by Smokey Yunick, America's most famous mechanic

Exhaust fumes

I have a 1975 Dodge Colt station wagon with a 1600-cc engine and four-speed standard transmission. Exhaust fumes enter the cargo area and rear passenger area during highway driving. The fumes are most noticeable on deceleration or cornering. The car has been back to the dealer five times over the last 15 months for this problem and everything has checked out okay: exhaust system, all body holes plugged, and tailgate light. A telephone call to Chrysler indicates no service bulletins issued or known problems with the vehicle. Can you shed some light on the problem?

Robert W. Rader, Meriden, Conn.

Move the exit tail pipe back, right, or left. A good way to find a place to move it would be to tape some 10-inch ribbons to all possible areas you can move or extend the pipe to. Have someone sit in back and watch the ribbons during deceleration and cornering. Move the pipe until you find a spot where ribbons stay out and don't drop or go forward. It's really an engineering problem, not yours. But if Chrysler won't respond, you should fix it. This could be very dangerous if it occurs at road speed.

Convert to propane?

Can you tell me where I can get a rundown on the practicality of converting my pickup (¾-ton) or truck (one-ton) to propane?

N.A. "Nels" Cheney, Costa Mesa, Calif.

Easy. Call Impco Carb—213-860-6666; ask for Herb Hill. They build good stuff, reasonably priced, and know what they are doing.

Propane is only practical for people who have ready access to the fuel at a lower-than-going-market price. But I caution you: Be sure you have proper compression and valve materials, or your bargain will backfire economically.

Can you do it yourself?

How do you feel about the upsurge in the do-it-yourself area? In your opinion can the average person do the majority of routine maintenance and repair tasks? Which ones should the rank amateur avoid or seek professional help with?

Ed Morris, Santa Clara, Calif.

There is a flood of do-it-yourself articles and manuals. Unfortunately most are based on making money rather than helping the poor motorist. My observations are that the biggest gain would be made if the interested party would study the basic operation of the vehicle, read the owner's manual cover to cover, and follow its instructions.

You could then decide what repair and maintenance items you could handle with your know-how and available tools and equipment, and also be able to accurately describe trouble symptoms to a knowledgeable technician, which saves time and money. A little knowledge helps in picking a fairly priced and knowledgeable garage, too.

One thing I've noticed in repair work: 75 percent of it is because of ignorance or neglect and abuse, 15 percent because of worn-out parts, and 10 percent because the car is put together wrong or defective from the factory.

Which vehicle to buy?

My wife and I are contemplating buying a suburban-type vehicle as our basic family transportation. We like the interior room they offer.

International Harvester, Chevrolet, and GMC all make them. We will not be towing with it, and as extras we would be getting power steering, power brakes, and air conditioning.

With economy and long-lasting durability in mind, which make and which engine transmission would you suggest that we purchase?

Fred Krajeski, Wenham, Mass.

I'm an International dealer, so I break it down like this. Size first. Scout is somewhat smaller than Chevy Blazer. (No use to talk to GMC. They offer a Chevrolet with another name.) If you want room and power, it's Blazer.

Economy in all of them stinks, for my money, but they get mileage similar to their counterparts in other body styles. Same goes for durability. The four-cylinder Scout is probably the best economy package; it has a pretty trouble-free engine and the ride's good. Probably an automatic with 3.54:1 rear axle will fit your needs.

Overheating problem

I have a 1974 Mustang II which has overheated since it was new. On a very warm day, in slow traffic, or climbing up even a moderate sustained grade, the temperature gauge will climb rapidly. The dealer has repeatedly said there is nothing that can be done. But I have been told by others that there are two possible fixes: (1) Changing the thermostat to one of, say, 160° F, or (2) replacing the radiator with a bigger one.

I understand the replacement of the thermostat would cost less. Would the

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remedy (or remedies) be harmful to the engine or its performance?

Jean L. Baures, San Francisco, Calif.

I'm assuming your engine is properly tuned, radiator and hoses all in good shape, no compression leak into the water system, and fan and belts also in good shape. If so, forget the thermostat shot and head for a bigger radiator. You shouldn't need a bigger radiator, though, if everything is normal—unless you are geared wrong for the terrain, too lean, using the wrong fuel for the compression of the engine, or running too much timing. By the way, 200° F is not too hot.

How accurate is the gauge? Maybe you're really not overheating.

A bad pressure cap or a leak under pressure anywhere, where you lose a little water, can trigger a heat problem.

Extra-heavy load or a trailer can also cause heat that a standard radiator can't handle. Any add-on gadgets in front of the grille or radiator? They can be bad news.

Radiators on new cars today are as borderline as they can get; anything out of standard operation will cause trouble. When you look at how today's radiators have shrunk, you'd think copper must be $55 a pound.

Fast-idle problem

I have a 1973 Cutlass automatic with a 50-cu.-in. engine Quadrajet carb, no AC. Since new, this engine has been plagued with high idle condition (800 rpm in drive) that has baffled many service stations. Checks were made for vacuum leaks, cylinder-head gaskets, etc., all emission controls were disconnected and plugged, the carb removed and checked out, and the distributor checked over. All were in good working order.

How is it possible for this engine to idle so high with the throttle valves *completely* closed? Is it possible the engine is getting gas through the small holes in the throttle valves? If so, shall I solder them closed? According to my last carb man, this condition is very common in Quadrajet carbs! As gas mileage is good, I hesitate to buy a new carb. Any suggestions?

F. Bogdan, Deer Park, N.Y.

You're on the right trail. Too much air. Pull the carb off and look around the throttle plates. You'll find a leak or a reason why the throttle won't cut the air supply down enough. If it's a small leak, such as with shaft clearances, squirt some oil on the suspect area, and watch the tail pipe. If you hit a nerve, the exhaust gas coming out of the tail pipe will be unusually dark in color.

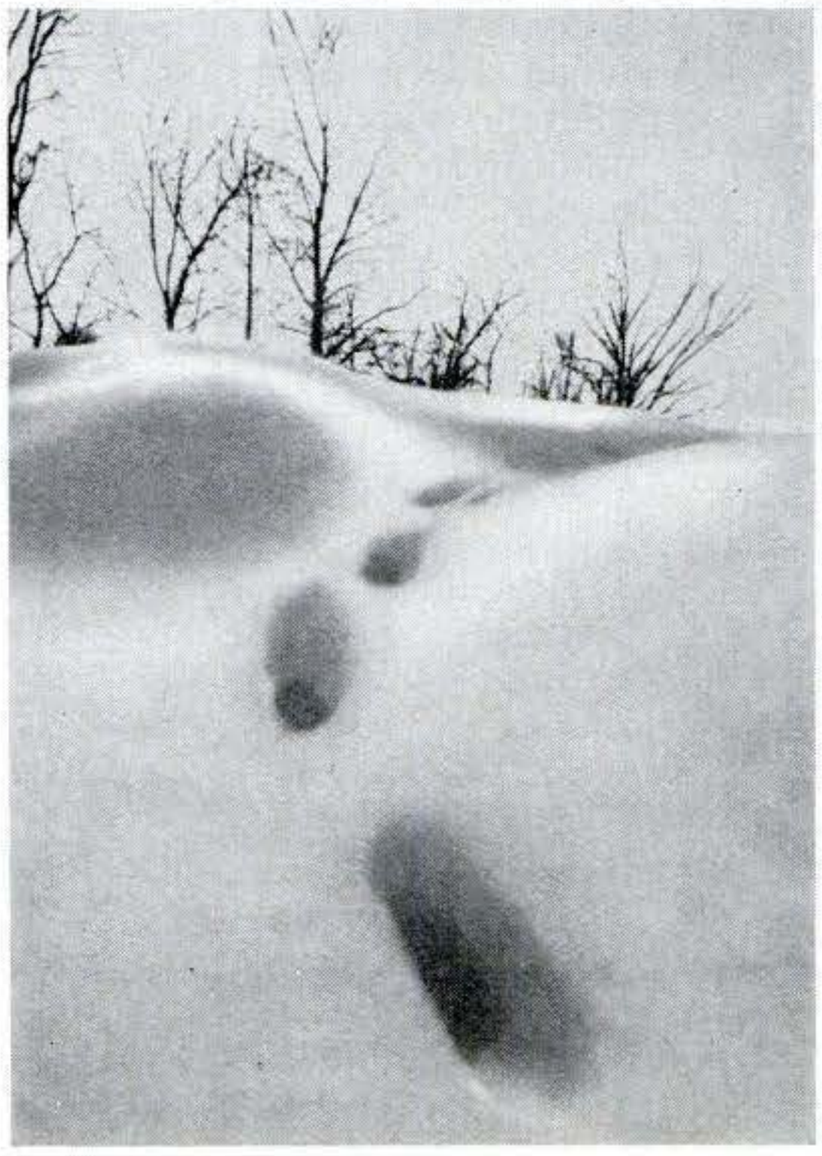
Each month in *Popular Science* Smokey Yunick answers questions on cars—family cars, high-performance jobs, hot rods, and racing cars—selected from those sent in by readers. Got a problem? Send it to: "Say, Smokey—" Popular Science, 380 Madison Ave., New York 10017. Questions cannot be answered by mail.

HOW TO INFLUENCE PEOPLE.

Nothing makes a man look more persuasive than taking a cigar out of a tube. And there's no better tubed cigar for the money than Royale by Gold Label. A stylish cigar with a rich Cameroon wrapper. And all the mildness and freshness sealed in by the tube. So take out a Royale and be impressive, even before you speak.

ROYALE *in a tube by Gold Label*

AMERICA BEGINS SEARCH FOR SURVIVORS.



They used to be easy to spot.

But today's fashion trend has produced a whole new crop of boots designed to look like the ones we've been making in Maine since 1879.

So you'll have to look a little harder for the original quality, craftsmanship and never-say-die durability of Herman SURVIVORS®.

When you find them, you'll know they were worth the search.

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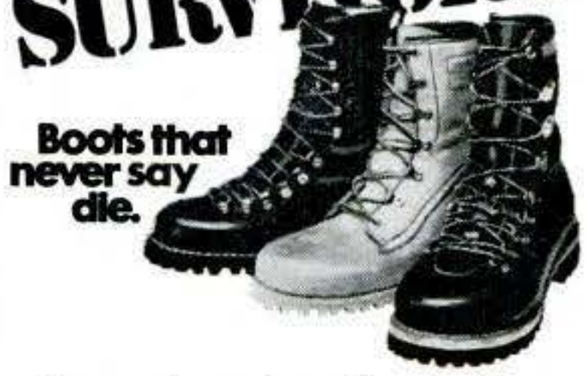

Boots that never say die.

For our color catalog and location of stores near you, write Joseph M. Herman Shoe Co., Inc., Dept. 61, Millis, MA 02054.

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The incredible tale of the 37-year puzzle

2000 readers sent solutions to a long-unsolved problem re-presented last February in "Readers Talk Back"

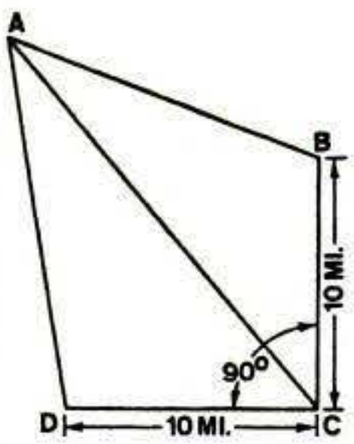
Darrell Huff—a frequent contributor to PS of articles on the use of pocket calculators to solve problems and play games—was a logical choice to receive the flood of puzzle responses. He's shown here organizing them, and reports that his own calculators came in handy for checking solutions. Next month, Huff starts a bimonthly column in PS called Calcu-letter.

By DARRELL HUFF

Our story has a cast of thousands, as they say in Hollywood—not to mention Howard Hughes in a bit part. The thousands have a couple of things in common. They are all readers of POPULAR SCIENCE and all determined to rescue R. F. Davis of Sun City, Ariz.

Thirty-seven years ago Dick Davis was a young writer-photographer living with a wife and baby daughter in a village near Concord, Mass. In September, 1939, he came upon a modest problem in the letters column of his new PS:

"Have enjoyed monkeying with the problems you print, for the last couple of years. Here's one that may make the boys scratch their heads a little: A man always drives at the same speed (his car probably has a governor on it). He makes it from A direct to C in 30 minutes; from A through B to C in 35 minutes; and from A through D to C in 40 minutes. How fast does he drive?



D.R.C., Sacramento, Calif."

Like a good many other readers that month—and again in February, 1977—Dick left the rest of the magazine unread for at least one evening.

The problem looked elementary—but it wasn't. Davis used every bit of math he could remember from the usual high-school courses and some meteorology encountered at Harvard. He went through his mother's old *Academic Arithmetic* and *A School Algebra* from the 1890's.

One day, many years and miles later, he found himself at the Los Angeles Public Library on a research errand for Howard Hughes, for whom he was doing public relations. On a hunch he called for the issues of POPULAR SCIENCE following the one with the puzzle. There he found one clue. This communication had appeared in November 1939:

"In regard to the problem submitted by D. R. C. of Sacramento, Calif., in the September issue. According to my calculations, the speed of the car must be 38.843 miles an hour. W.L.B., Chicago, Ill."

Without details or verification, this wasn't much help. But Davis continued to pursue the problem until last winter when, now retired in Sun City, Ariz., he capitulated after 37 years.

"All right," he wrote to Readers Talk Back. "I give up. What's the answer? Over the years I probably have shown the problem to more than 500 people . . . Now I'd like to challenge POPULAR SCIENCE. If your readers of today cannot solve this little problem (and prove the answer) how about finding the answer, editors—if there is one?"

Knowing that their own time is valuable while writers are an idle lot, the editors prudently bounced the thing my way. With considerable help from good luck and an idle thought that floated into my subconscious while waiting for a tennis court, I turned up a solution.

This solution, along with a tip on a different method I obtained from my one-time college math instructor, James Booher, emboldened the editors to publish Davis's challenge in the February issue. Their designated hitter had come up with a couple of solutions, the editors said, and "we'd like to see what you readers can do before we publish his answers."

Record-breaking replies

Over the next couple of months, "you readers could do" all this:

Throw the magazine's mail room out of joint with a record bulk of almost 2000 communications on a single subject. Produce the correct answers—yes, there are two—using at least five distinctly different approaches. (You'll find all five on the following pages.) So discommode the busy editors that they passed the whole thing along to me in large cartons, to be analyzed and reported on (see photo).

Despite the difficulty of the

Continued

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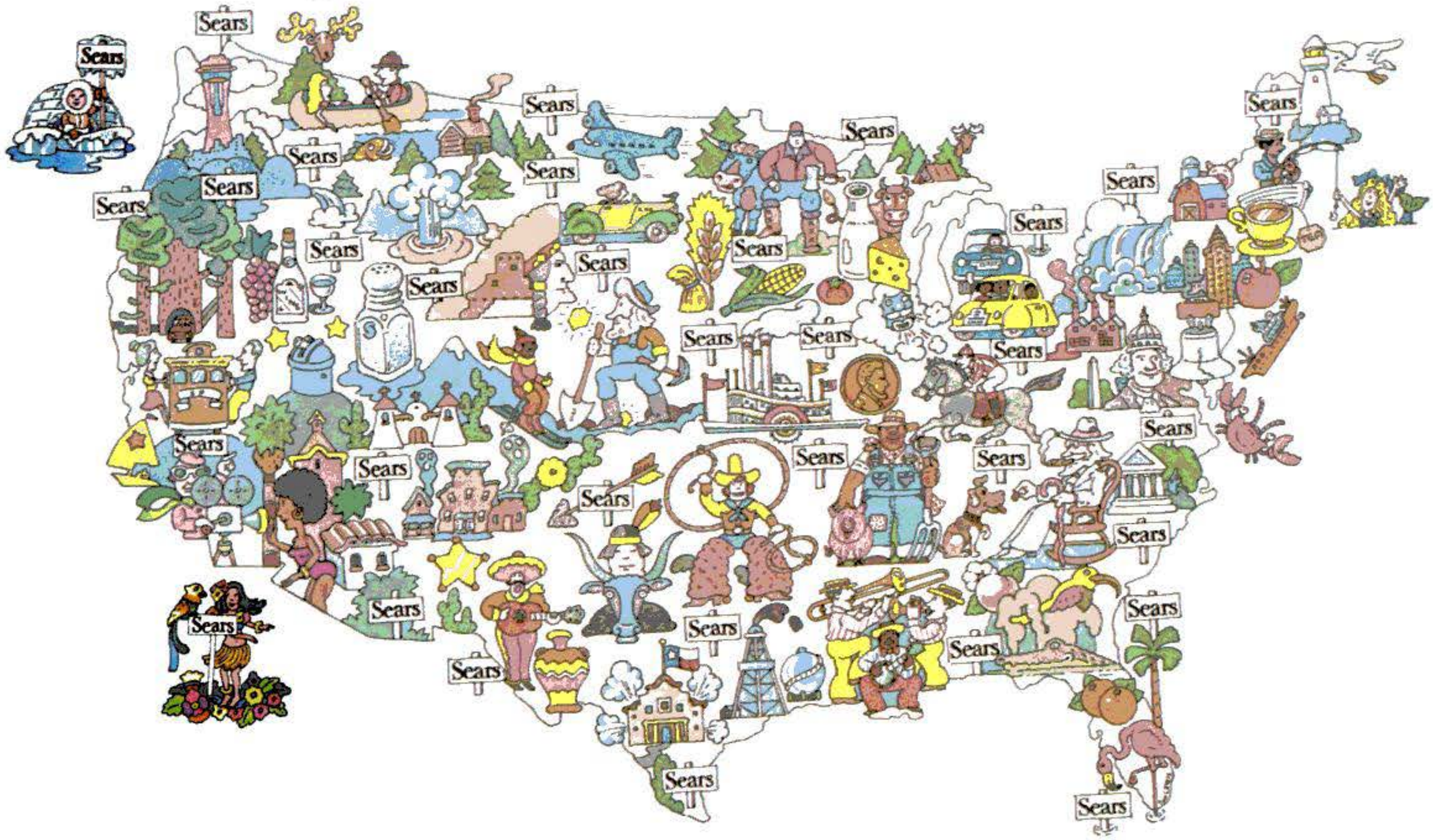

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ADDRESS	CITY	STATE	ZIP	HOW LONG

☐ OWN ☐ BOARD ☐ RENT	MONTHLY RENT OR MORTGAGE PAYMENTS	SOCIAL SECURITY NUMBER	PHONE NUMBER	NUMBER OF DEPENDENTS

FORMER ADDRESS (IF LESS THAN 2 YEARS AT PRESENT ADDRESS)	HOW LONG	OCCUPATION	NET EARNINGS	☐ MONTHLY ☐ WEEKLY

EMPLOYER	ADDRESS	CITY	STATE	ZIP	HOW LONG

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OTHER INCOME IF ANY: AMOUNT $	**Alimony, child support, or separate maintenance income need not be revealed if you do not wish to have it considered as a basis for paying this obligation.**	SOURCE OF OTHER INCOME

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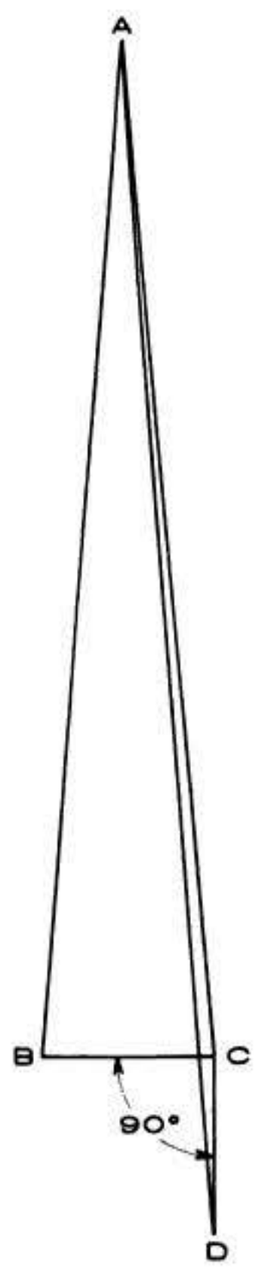
problem, a solid three-quarters of those who responded came up with the right answers, usually accompanied by detailed explanations of how they got them.

These answers, carried to an extreme by one of the several solvers who had computers available, are 38.84305770085153 and 119.8138-15331676 miles per hour. Most contributors limited themselves to a reasonable eight digits or fewer, the capacity of the usual pocket calculator.

Nearly everyone who found one answer also found the second. The reason: However they started, they usually ended up with a quadratic equation. It is the nature of such an equation to have two roots, of which one often may be rejected on logical or mathematical grounds.

Some contributors vetoed nearly 120 mph on the grounds that it did not fit the figure as published (true). But many others agreed that a new figure could be drawn for that speed, meeting all requirements including the right angle. The drawing (right) shows what it looks like. Many who threw out the higher speed on non-mathematical grounds called it wasteful, illegal, or simply impossible, at least in 1939. "Obviously a fuelish person," was one comment.



E. O. Roberts, Coquitlam, B.C., says he recognized the place right away: "Airdrie to Calgary via Borden or Dicksburg. But they've put in school zones and stop signs since 1939 and now they've got a traffic light at Dicksburg. And one of them Queen's cowboys that has the yeller streaks on his legs gave me a ticket for doing 38.843 in a 30-mile zone."

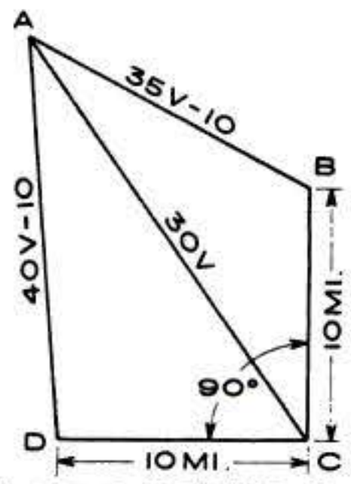
Of the few puzzle fans who reached only the 38.843 solution, most used a method called iteration. That's the hifalutin word for what was called trial and error until calculators and computers came along and made it respectable (i.e., fast and easy).

Applied to this problem, it means starting with the same equations, usually the trig ones, but bypassing a lot of involved algebra by guessing a solution and then testing it for fit. It is, as one user, R. R. Funk, Knoxville, Tenn., remarked, "a very powerful technique, not used very much, since most people have an aversion to starting with a wrong answer."

Anyone fearing that computers are about to take over the world will be comforted to note that GIGO (garbage in: garbage out)

Continued

The popular cosines



Most readers who solved the problem used some form of the law of cosines, which says that the cosine of any angle of a triangle equals the sum of the squares of the adjacent sides less the square of the other side, all divided by twice the product of the adjacent sides.

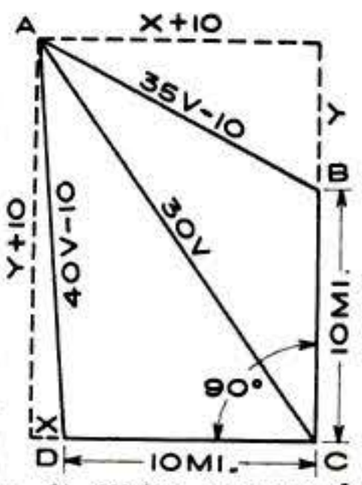
Applying this to the figure (and simplifying) shows that the cosine of the angle ABC is equal to 1/6 of 7 — 3.25v. And the cosine ACD equals 1/6 of 8 — 7v. When these two values are squared and added together they equal 1.

This follows from the rule, to be found in math books or easily derived in a few steps, that when two angles add up to 90° the sum of the squares of their cosines is 1.

Simplifying this equation and combining the terms on one side produces a quadratic equation, for which there is a standard solution that yields two roots. A convenient form of this solution that I've worked out for calculators calls for dividing the coefficients of the second and third terms by twice the coefficients of the first. Now square the first of these results and subtract twice the second from it. Find the square root. Now, separately, add this to and subtract this from that first result.

These are the two roots of the equation. Multiplied by 60 to change them from minutes to miles per hour, they become 38.843058 and 119.81382, the answers to the problem.

Construct a rectangle



Adding lines that complete a rectangle points the way to perhaps the simplest solution. After this shrewd move, only the well-known Pythagorean theorem and some standard algebra are needed for the solution. In its most direct form, the procedure is to use the given information to label the parts, as shown. Then: 1) Write square-of-the-hypotenuse equations for the three right triangles of which AC, AD, and AB are the hypotenuses. 2) Subtract the second equation from the first and find the value of x. Subtract the third from the first and solve for y. 3) Substitute these values for x and y in the first equation.

Having simplified this and divided by v^2, allowable since v can't be equal to zero (or the car wouldn't move at all), you'll have a quadratic equation. Solving this, as described above, under "The Popular Cosines," produces the answers.

Not everyone using this geometric method drew quite the same picture. A few readers preferred to draw the line parallel to DC through B instead of through A.

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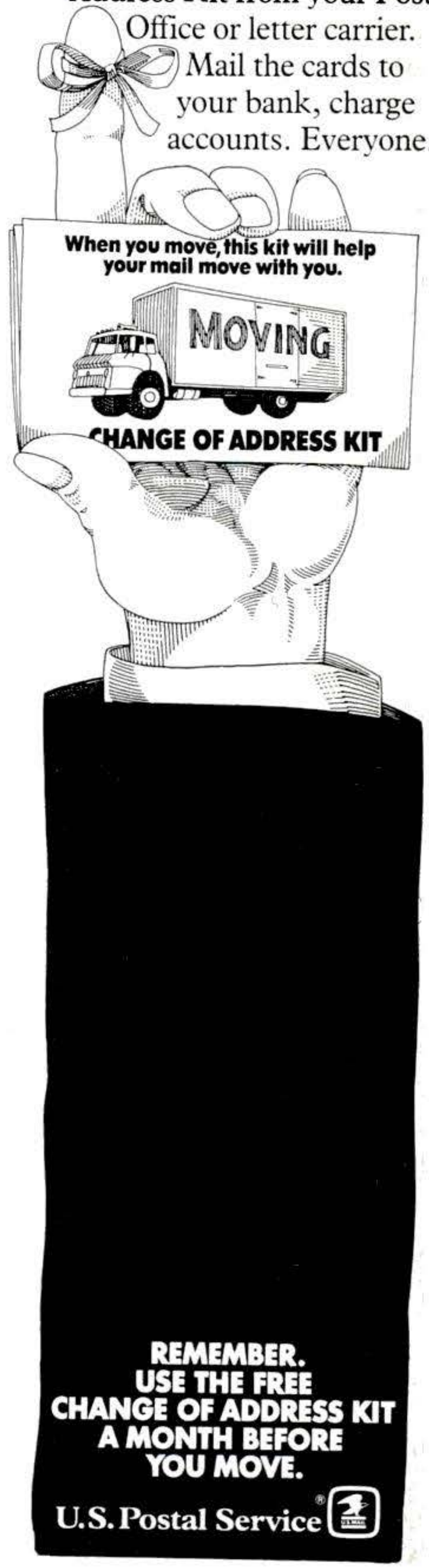

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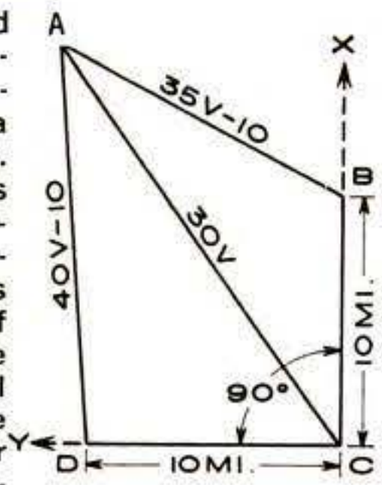
A map called analyt



Readers who had studied—and remembered—analytic geometry proceeded with a minimum of labor. What they used is formally called a system of Cartesian coordinates, which is really just a kind of map. After a reference point is chosen, all other points can be located by how far from it they are vertically and how far horizontally. When this is done for the routes in our puzzles, rules equivalent to the familiar square-of-the-hypotenuse theorem produce a set of equations.

Calling the upward direction x and the horizontal one y, the equation for the direct route AC is $x^2 + y^2 = 900v^2$. Using comparable equations for the other two routes and giving them the algebraic treatment described under "Construct a Rectangle" produces a similar quadratic equation and the same answers.

Several readers reached their initial equations in a somewhat different manner. They thought of the starting point as the intersection of the three circles having as centers the other three given points.

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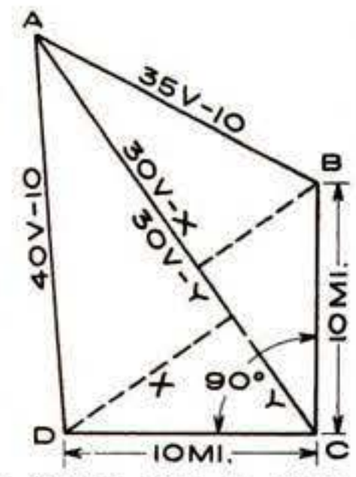
still holds. Thus one contributor went wrong on his initial equations and confidently submitted an impressive computer printout that unfolded to more than seven feet long, announcing that the motorist's speed was precisely 41.455297 mph.

Though reasonably close, this answer is much further off base than almost any of the ones obtained simply and quickly by readers who measured instead of calculating. These scalers made up some three percent of the contributors. Only a couple of them chose

[*Continued on page 190*]

Internal triangles

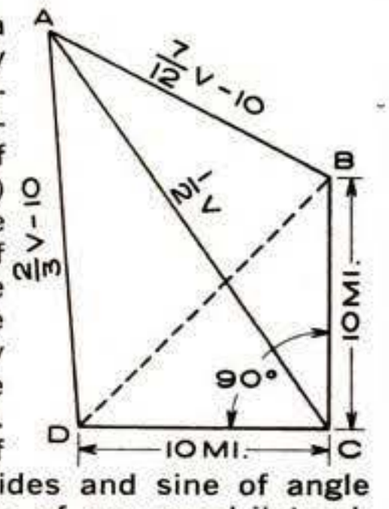


Many readers found it useful to draw lines from B and D perpendicular to AC, forming four right triangles. Using the familiar Pythagorean theorem, they easily wrote an equation for each of the upper and one of the two identical lower triangles.

They simplified each of the first two equations and solved them for x and y. They squared them, added them together, and substituted the value for $x^2 + y^2$ from the third equation. Simplifying once more brought them to a quadratic equation that could be solved as described under "The Popular Cosines."

A few readers drew a line from B to D instead and then dropped perpendiculars to it from A and C, forming a splendid collection of right triangles.

Area formulas



About one solver in a hundred ingeniously made use of area formulas: 1) Right triangle: half product of two shorter sides. 2) Any triangle: square root of product of half the sum of the sides times three quantities found by subtracting each side from half their sum. 3) Any triangle: half product of any two sides and sine of angle between them. 4) Area of any quadrilateral: subtract squares of two opposite sides from sum of squares of other two sides. Subtract square of this result from four times product of squares of the diagonals, then divide the square root of this by 4.

Most then formed a pair of equations by labeling parts in mph and setting the area of each initial triangle (by formula 2) equal to its area (by formula 3). The procedure then was much as described under "The Popular Cosines."

A variation, from Jim Knudson, Boise, Idaho, sets equal the sums of the areas of the original triangles and of the new ones formed when line AC is ignored and BD is drawn. Simplifying and substituting yields an equation solvable by iteration.

Lawrence D. Pesce of Memphis, Tenn., used the rare quadrilateral formula to set the whole area minus area BCD equal to area ABD. Squaring, substituting, and rearranging gave him the quadratic equation.

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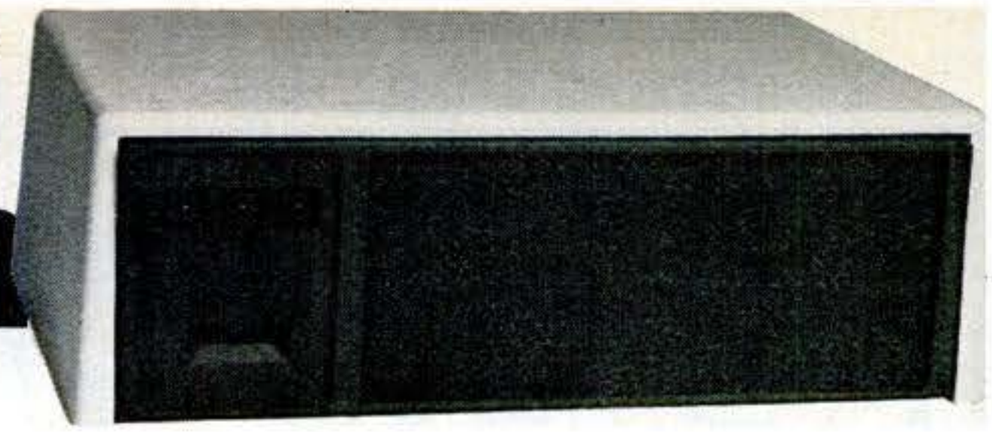
Burglar Alarm Breakthrough



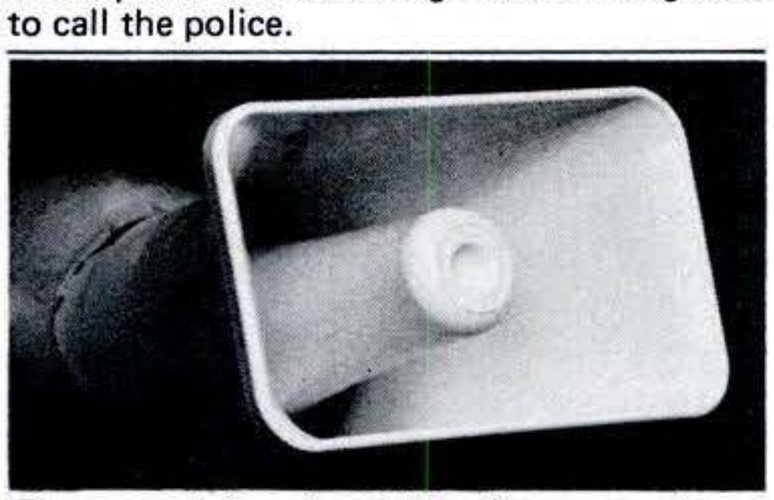
The Midex security computer looks like a handsome stereo system component and measures only 4" x 10½" x 7".

A new computerized burglar alarm requires no installation and protects your home or business like a thousand dollar professional system.

It's a security system computer. You can now protect everything—windows, doors, walls, ceilings and floors with a near fail-safe system so advanced that it doesn't require installation.

The Midex 55 is a new motion-sensing computer. Switch it on and you place a harmless invisible energy beam through more than 5,000 cubic feet in your home. Whenever this beam detects motion it sends a signal to the computer which interprets the cause of the motion and triggers an extremely loud alarm.

The system's alarm is so loud that it can cause pain—loud enough to drive an intruder out of your home before anything is stolen or destroyed and loud enough to alert neighbors to call the police.



The powerful optional blast horns can also be placed outside your home or office to warn your neighbors.

Unlike the complex and expensive commercial alarms that require sensors wired into every door or window, the Midex requires no sensors nor any other additional equipment other than your stereo speakers or an optional pair of blast horns. Its beam actually penetrates walls to set up an electronic barrier against intrusion.

NO MORE FALSE ALARMS

The Midex is not triggered by noise or sound, temperature or humidity—just motion, and since a computer interprets the nature of the motion, the chances of a false alarm are very remote.

An experienced burglar can disarm an expensive security system or break into a home or office through a wall. Using a Midex system there is no way a burglar can penetrate the protection beam without triggering the loud alarm. Even if the burglar cuts off your power, the four-hour rechargeable battery pack will keep your unit triggered, ready to sense motion and sound an alarm.

DEFENSE AGAINST PEEPING TOMS

By pointing your unit towards the outdoors from your bedroom and installing an outside speaker, light, or alarm, your unit can sense a peeping tom, and frighten him off. Pets are no problem for the Midex. Simply put them in one section of the house and concentrate the beam in another.

When the Midex senses an intruder, it remains silent for 20 seconds. It then sounds the alarm until the burglar leaves. One minute after the burglar leaves, the alarm shuts off and resets, once again ready to do its job. This shut-off feature, not found on many expensive systems, means that your alarm won't go wailing all night long while you're away. When your neighbors hear it, they'll know positively that there's trouble.

PROFESSIONAL SYSTEM

Midex is portable so it can be placed anywhere in your home. You simply connect it to your stereo speakers or attach the two optional blast horns.

Operating the Midex is as easy as its installation. To arm the unit, you remove a specially coded key. You now have 30 seconds to leave your premises. When you return, you enter and insert your key to disarm the unit. You have 20 seconds to do that. Each key is registered with Midex and that number is kept in their vault should you ever need a duplicate. Three keys are supplied with each unit.

As an extra security measure, you can leave your unit on at night and place an optional panic button by your bed. But with all its optional features, the Midex system is complete, designed to protect you, your home and property just as it arrives in its well-protected carton.

The Midex 55 system is the latest electronic breakthrough by Solfan Systems, Inc.—a company that specializes in sophisticated professional security systems for banks and high security areas. JS&A first became acquainted with Midex after we were burglarized. At the time we owned an excellent security system but the burglars went through a wall that could not have been protected by sensors. We then installed over $5,000 worth of the Midex commercial equipment in our warehouse. When Solfan Systems announced their intentions to market their units to consumers, we immediately offered our services.

COMPARED AGAINST OTHERS

In a recent issue of the leading consumer publication there was a complete article written on the tests given security devices which were purchased in New York. The Midex 55 is not available in New York stores but had it been compared it would have been rated tops in space protection and protection against false alarms—two of the top criteria used to evaluate these systems. Don't be confused. There is no system under $1,000 that provides you with the same protection.

YOU JUDGE THE QUALITY

Will the Midex system ever fail? No product is perfect but judge for yourself. All components used in the Midex system are of aerospace quality and of such high reliability that they pass the military standard 883 for thermal shock and burn-in. In short, they go through the same rugged tests and controls used on components in manned spaceships.

Each component is first tested at extreme tolerances and then retested after assembly. The entire system is then put under full electrical loads at 150 degrees Fahrenheit for a full week. If there is a defect, these tests will cause it to surface.

PEOPLE LIKE THE SYSTEM

Wally Schirra, a former astronaut and scientist, says this about the Midex 55, "I know of no system that is as easy to use and provides such solid protection to the home owner as the Midex. I would strongly recommend it to anyone. I am more than pleased with my unit."

Many more people can attest to the quality of this system but the true test is how it performs in your home or office. That is why we provide a one month trial period. We give you the opportunity to personally see how fail-safe and easy the Midex system is to operate and how thoroughly it protects you and your loved ones.

Use the Midex for protection while you sleep, to protect your home while you're away or on vacation. Then after 30 days, if you're not convinced that the Midex is nearly fail-safe, easy to use, and can provide you with a security system that you can trust, return your unit and we'll be happy to send you a prompt and courteous refund. There is absolutely no obligation. JS&A has been serving the consumer for over a decade—further assurance that your investment is well protected.

To order your system, simply send your check in the amount of $199.95 (Illinois residents add 5% sales tax) to the address shown below. Credit card buyers may call our toll-free number below. There are no postage and handling charges. By return mail you will receive your system complete with all connections, easy to understand instructions and one year limited warranty. If you do not have stereo speakers, you may order the optional blast horns at $39.95 each and we recommend the purchase of two.

With the Midex 55, JS&A brings you: 1) A system built with such high quality that it complies with the same strict government standards used in the space program, 2) A system so advanced that it uses a computer to determine unauthorized entry, and 3) A way to buy the system, in complete confidence, without even being penalized for postage and handling charges if it's not exactly what you want. We couldn't provide you with a better opportunity to own a security system than right now.

Space-age technology has produced the ultimate personal security system. Order your Midex 55 security computer at no obligation, today.

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New home computers can change your life-style

They're cheaper and easier to use—and now they're available to everyone

By WILLIAM J. HAWKINS

Until now, to operate a home computer you had to be part electronic engineer, part programmer, part handyman, and part lucky. If you read my previous story [PS, May], you know that most hobby units available have been pretty complicated and time-consuming. Success in building and operating them has been reserved for the devoted electronic enthusiast.

But that's all changing: A new generation of home computers is beginning to emerge. With these, you take 'em home, plug 'em in, and begin using them. Costs vary widely and there's a lot of market maneuvering, but the central fact is that now—or very soon—everyone can have at his command affordable computing power, power that until recently has been available only to corporations and other big-money institutions. It's bound to have a major impact on the way we all live, in ways we can now only dimly imagine.

As reported last December, the home-computer movement really began about five years ago. That's when a company called MITS began producing the first computer kit for hobbyists. The idea caught on slowly at first (as did CB), but has exploded: Computer shops and clubs are springing up across the country. New magazines, books, and

Continued

You can become an expert at running Commodore's new $595 PET computer in a couple of hours, says the maker. Anyone can program it. The preassembled model (left) has 4K of RAM.

Heath H-8 is 8080-based with control keyboard and LED display for register readout. New H-11 model uses DEC LSI-11.

Radio Shack system includes full ASCII keyboard, TV monitor, and Z-80 microprocessor. Unit comes prewired only.

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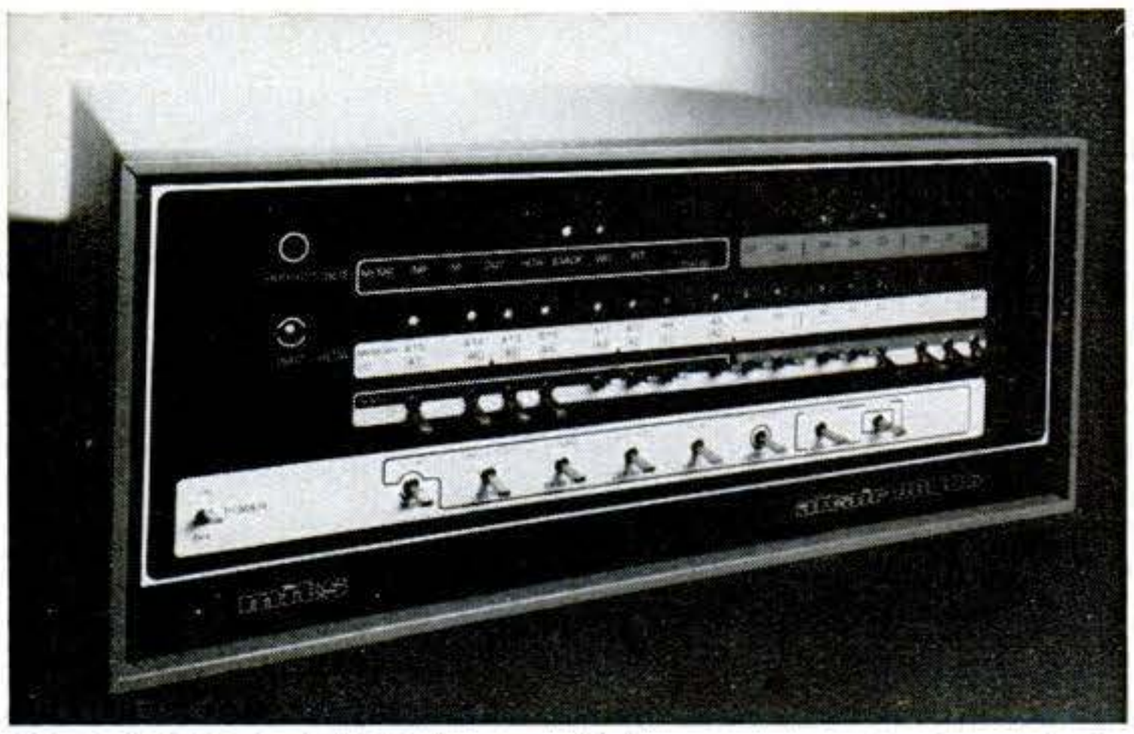
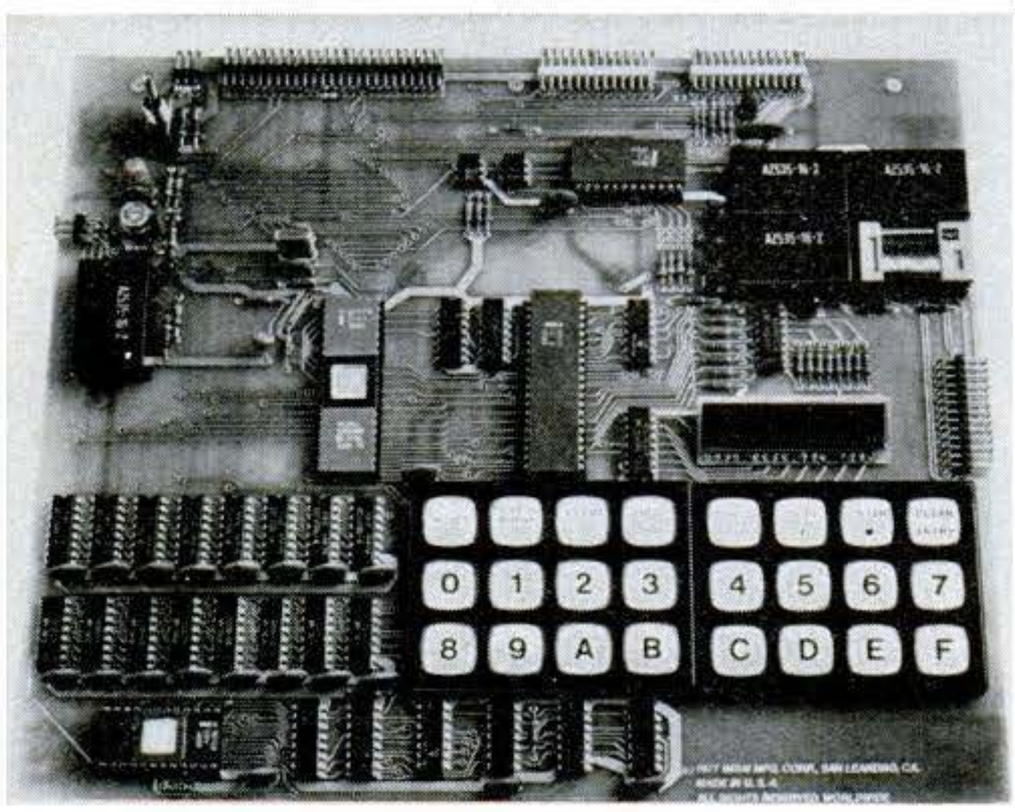


Altair 8800 by MITS is one of the most popular home-hobbyist computers. 8080-based, it comes prewired or as a kit.

Southwest Technical's 6800 system has just two buttons: power and reset. MIKBUG PROM runs system from keyboard.



Single-board 8048 from IMSAI requires just a six-volt battery to control home items—such as heat, lights, appliances.

Sol from Processor Technology has entire 8080 system in walnut-grained keyboard; plug-in modules personalize use.

newsletters dealing with the subject are appearing monthly.

New brands began to emerge as well. Well known to computer hobbyists, makers such as IMSAI, SWT, PolyMorphic, Processor Technology, TDL, Cromeco, and many others have been producing exceptional products for some time.

But with growing competitive pressure, changes are coming—fast. Sophistication and ease of operation are headed up while prices are headed down. Units are not designed just for the hobbyists, but for almost anyone who can put in a plug.

MITS, for example, makes the model 680b (shown in the May article) which is specifically designed for the beginner. IMSAI offers a computer on a board, made to do jobs around the house—everything from running model trains to controlling the heat. Processor Technology produces the SOL desktop keyboard/computer in a walnut case. And while Compucolor is being sold through many computer stores, it is now also available from Macy's.

The latest entries are well-known brands: Heath, Sears, and Radio Shack. They will rely heavily on both their stores and mail-order systems for sales. While the Radio Shack and Sears units come prebuilt only, the two Heathkit models are available in kit form. The long-time kit designers are sure to remove a lot of the guesswork that has been a part of a do-it-yourself computer until now. The Commodore PET unit is a prebuilt, all-in-one device that can be programmed by anyone; the cassette tape that comes with it directs the computer, which then teaches you how to use it. You can become an expert in a couple of hours. It comes with enough memory to run BASIC, an easy-to-understand computer language. PET's keyboard prints standard letters or graphics on the TV screen to produce graphs, charts, or photos. If Commodore's and Radio Shack's plans succeed (they're not on the market at this writing), these units will be available by the time you read this at an unbelievably low $595.

Unbelievable, because a comparably equipped system now costs $1000 or more. And that brings up the matter of price, which, in this field is so tricky that it can take a computer to figure it out. First fact: Prices vary enormously depending on exactly what you include in the "system." For instance, you can buy a microcomputer for $300 or even less—but it won't do anything but sit there and perhaps hum. You need memory for storage, peripheral equipment such as a keyboard or video screen for putting in information and taking it out again, tape systems for saving programs, and a host of special circuitry to do such things as

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graphics. So depending on what you need, costs can run up rapidly.

But if history is an example, the price trend will be down from here on. Over the next year or two, other brands are sure to come on the market. A few years ago, we saw hand calculators go from $400 when first introduced to a low of $10 or less now.

If you're worried about programming, don't—you can be an expert in just a few hours learning the standard BASIC language that these machines will use.

BASIC is simply that: a basic, simple way to communicate with a computer. It is a program designed to convert *your* program into machine codes—a bunch of letters and numbers—that the computer can understand.

If you want the computer to

Continued

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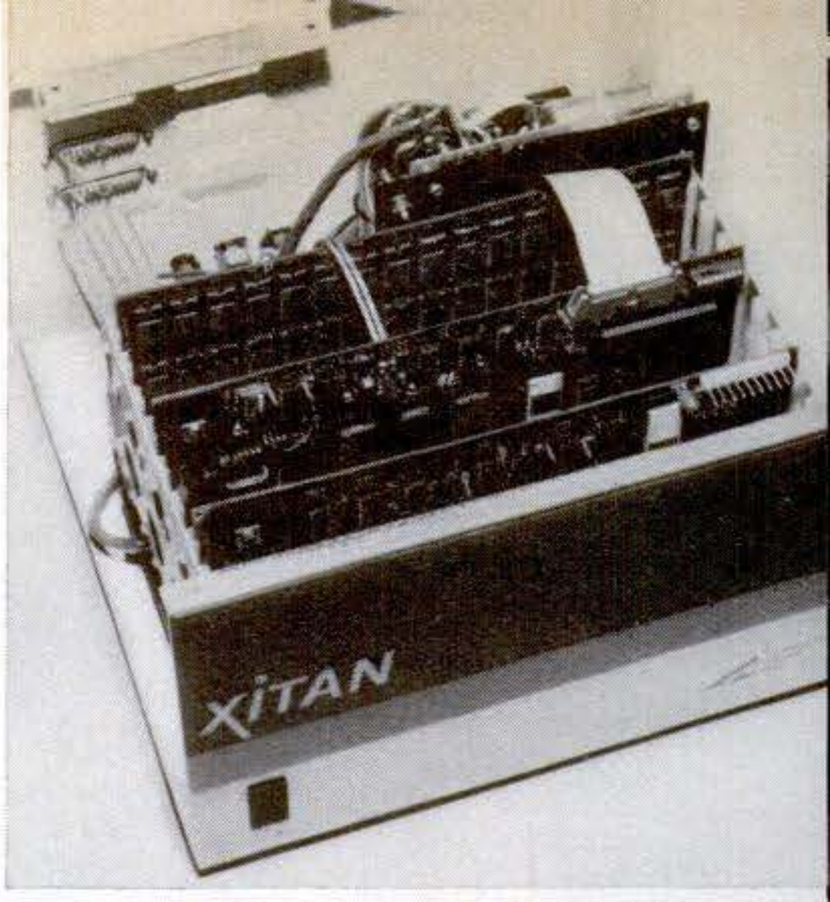
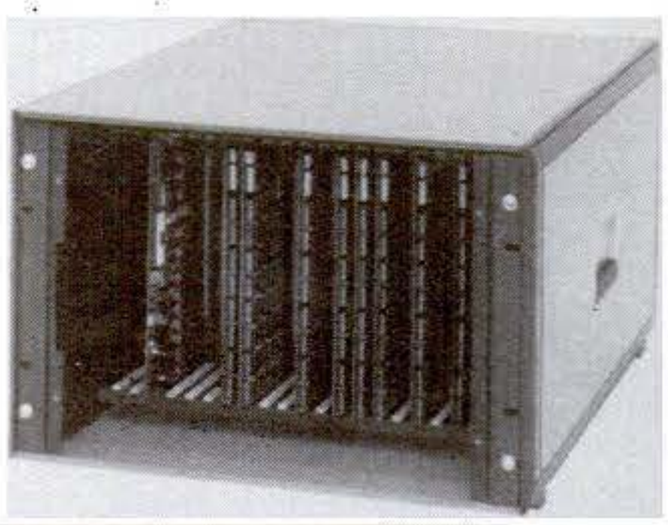


Technical Design Labs Z-80 Xitan uses a new monitor board that accepts TDL's relocatable software directly.

Compucolor uses a large color graphics display to present two different sizes of print type or, as shown, actual pictures.

The Digital Group offers separate units in similar, modern packages: tape deck, CPU, keyboard, printer, TV monitor.



Cromeco Z-2 system uses the Z-80 microprocessor. An internal switch selects either 2- or 4-MHz operational speed.

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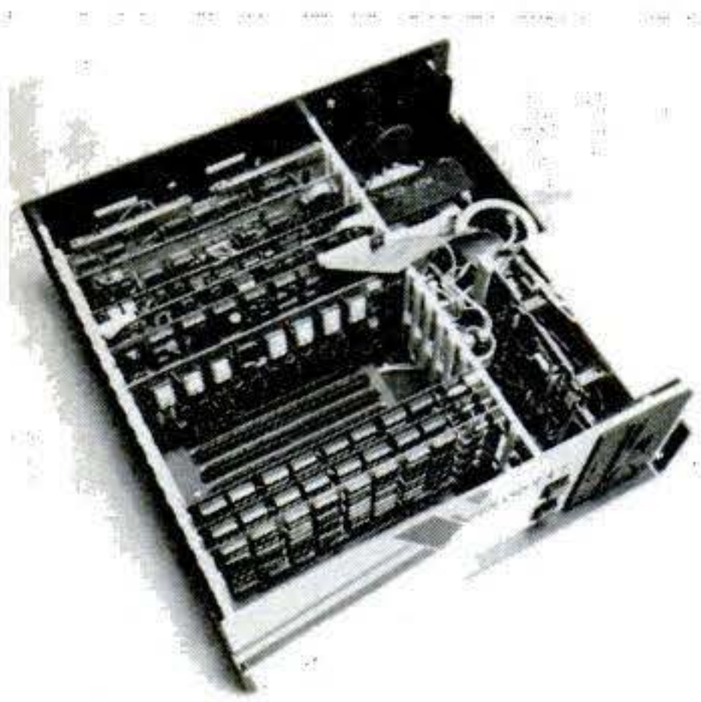
Poly 88 from PolyMorphic Systems uses a nine-inch video monitor, ASCII keyboard and audio cassette deck.



Vector Graphic Vector 1+ is 8080-based and has a cutout front panel to accept a Shugart minifloppy drive.

print out the word "hello" on the TV screen, for example, it would take about 20 special machine instructions to do it. In BASIC, however, you simply type in: PRINT "HELLO."

Math is done just as easily since BASIC uses the normal math signs (+, −, /, *) to represent addition, subtraction, division, and multiplication. Two and two is simply: PRINT 2+2, and the computer will print out 4 on the screen. And, with most versions of BASIC, you can also use trig functions, square root, and engineering notation by simply specifying a symbol.

But BASIC is only one program, and the software that will accompany the new computers will be just as important as the unit itself. At present, costs vary enormously: BASIC, for example, costs as much as $200 at one company and as little as $10 at another.

Plans for the newer systems, however, look good to our pocketbook. BASIC is usually thrown in with the computer when you buy; other special programs—games, income tax, info storage—will be sold at normal prices, between $5 and $20.

In your home

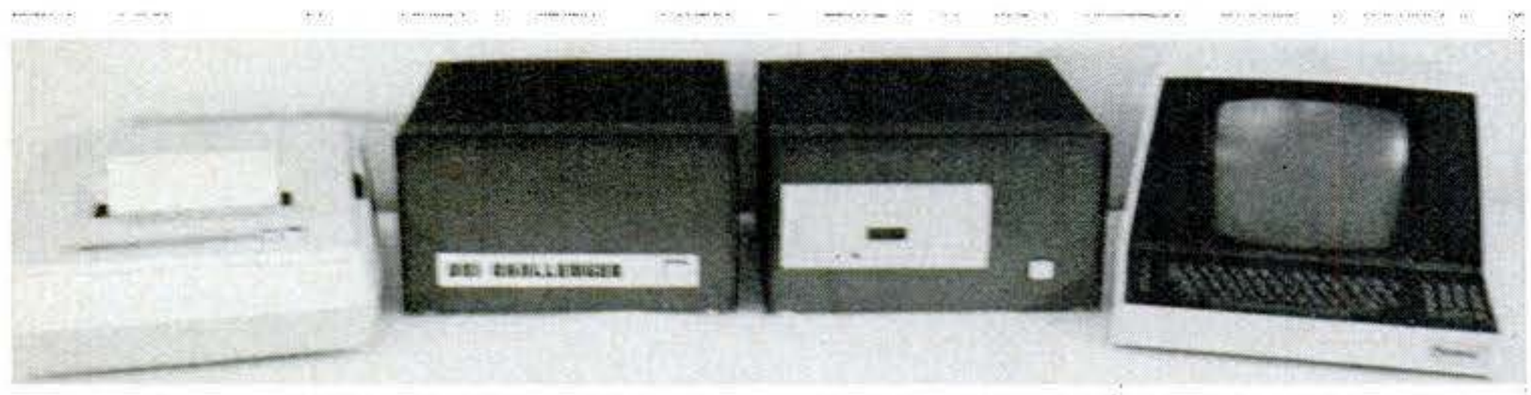
Okay, the prices are dropping, the computers are simpler to use, and they're easily available. But what will you do with them around the house?

On a diet? Tell the computer and it will plan your menu for each meal, forecast your caloric intake, and predict your weight loss for the next month.

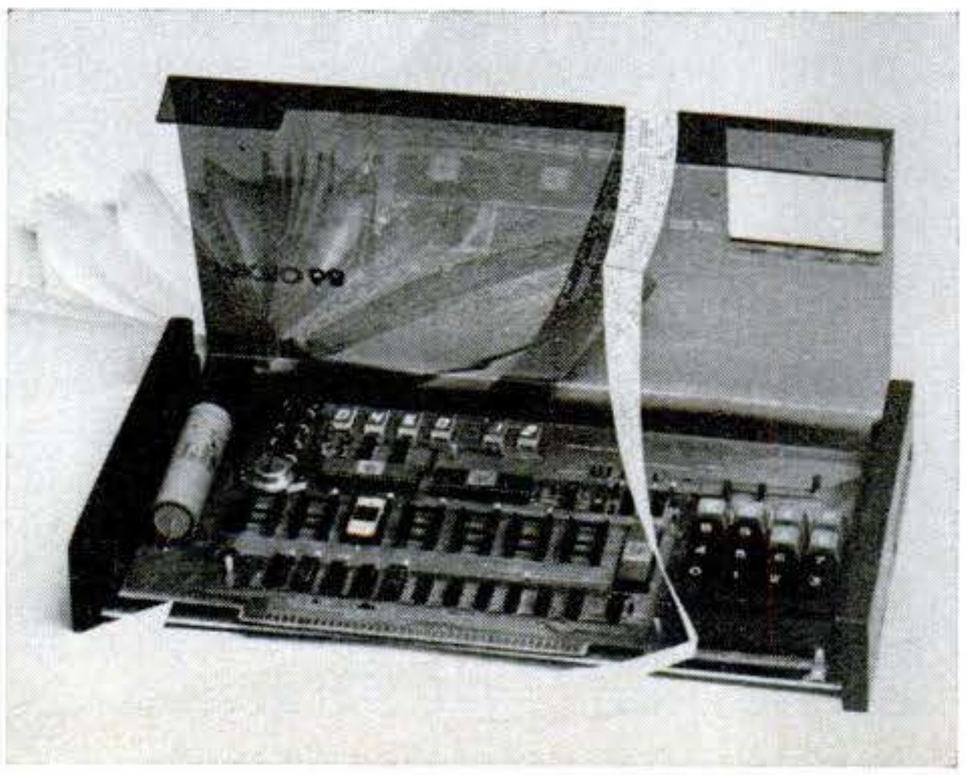
Need a loan (perhaps to pay for the computer)? It can compute when and where to get it, how and when to pay it back to cost you as little as possible.

Budgets, income taxes, mass storage (perhaps of frequently called phone numbers) for instant recall, "canned" programs to tutor your children at home, appointment reminder, or games such as chess—a computer can do those and many other jobs.

But the ultimate impact these home computers will have on our lives will, I believe, be far greater than just playing games or balancing our checkbooks. Major inventions have always changed our society in ways that could not be predicted. PS



Challenger system from OSI includes printer, CPU, floppy disc, TV terminal, and 65K of RAM. Unit comes assembled and uses a 6502 microprocessor.



Hexidecimal keyboard allows operation of this EPA 6800 system. LED's display memory contents. Peripherals can connect with accessory adapter.

MANUFACTURERS

Commodore, 901 California Ave., Palo Alto CA 94304. **Compucolor Corp.,** Box 569, Norcross GA 30091. **Cromeco Inc.,** 2432 Charleston Rd., Mountain View CA 94043. **The Digital Group,** Box 6528, Denver CO 80206. **EPA,** Electronic Product Associates, Inc., 1157 Vega St., San Diego CA 92110. **Heath Company,** Benton Harbor MI 49022. **IMSAI Man. Corp.,** 14860 Wicks Blvd., San Leandro CA 94577. **MITS,** 2450 Alamo St., SE, Albuquerque NM 87106. **OSI,** Ohio Scientific Inst., 11679 Hayden St., Hiram OH 44234. **PolyMorphic Systems,** 460 Ward Dr., Santa Barbara CA 93111. **Processor Technology (Sol),** 6200 Hollis St., Emeryville CA 94608. **Radio Shack,** 2617 W. 7th St., Fort Worth TX 76107. **SWT,** Southwest Technical Products, 219 W. Rhapsody, San Antonio TX 78216. **TDL,** Technical Design Labs, Research Park, Bldg. H., 1101 State Rd., Princeton NJ 08540. **Vector Graphic Inc.,** 790 Hampshire Rd., Westlake Village CA 91361.

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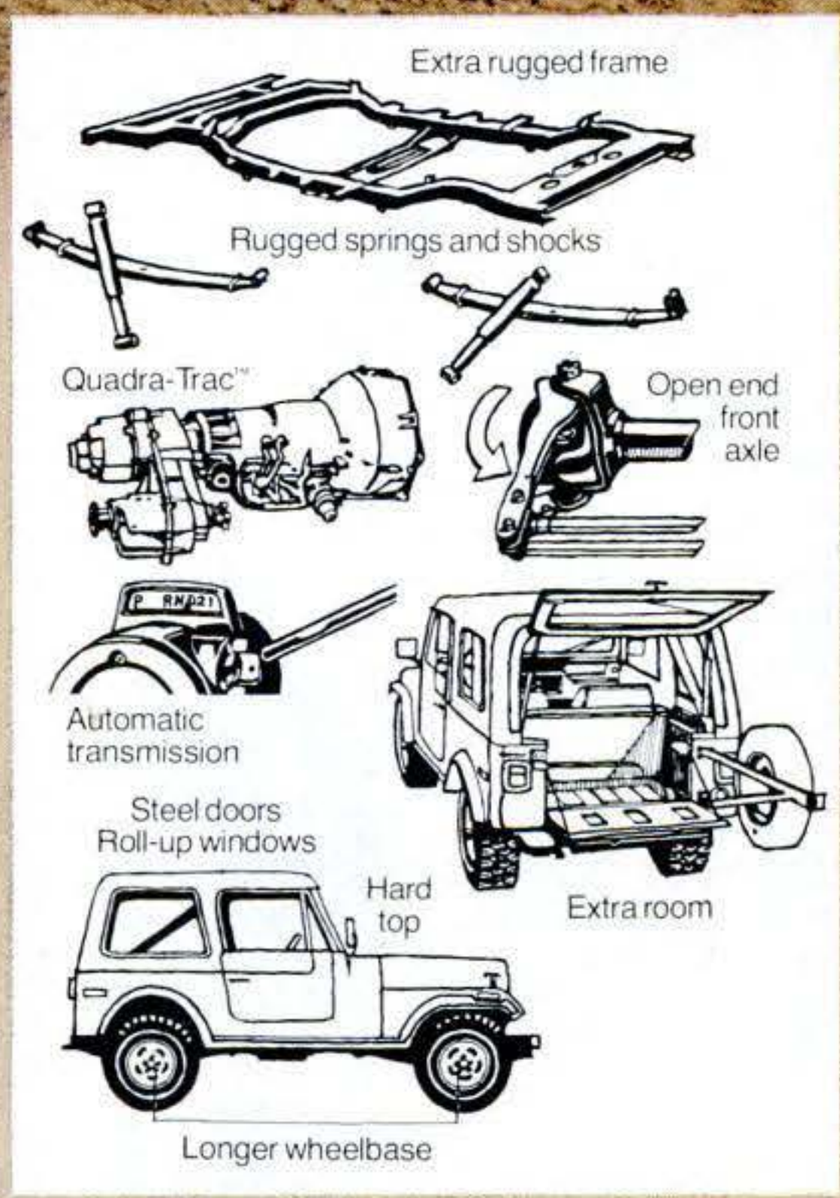

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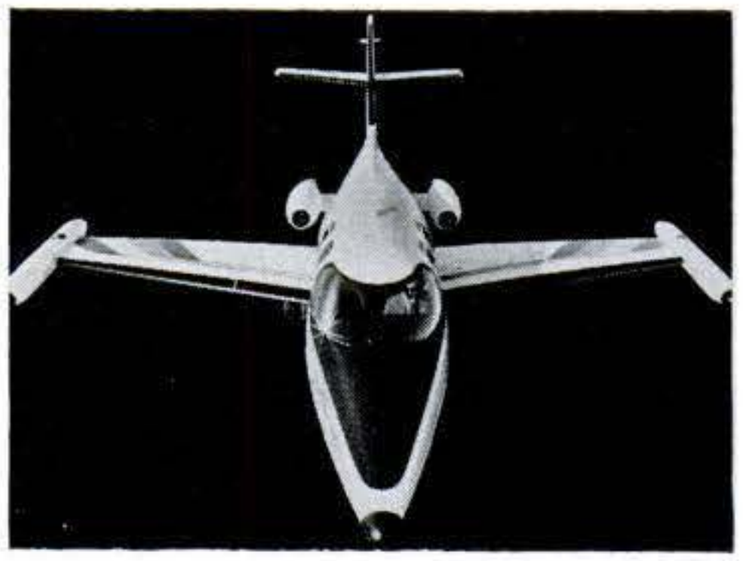

Sleek, compact, roomy, economical—and a bargain at an estimated $350,000. That's a half to a third the price of other corporate jets.

The twin-engine, single-pilot Foxjet ST-600 is due for its first flight in June, 1978. And if computer projections, based on engine tests, are correct, its fuel cost per mile will be nine cents, says the developer, Tony Fox, president of Tony Team Industries (TTI), Minneapolis, Minn. That's a hefty savings over the average 50 cents to $1.25 per mile for other business jets.

Although the aircraft is about half as big as a Learjet, its cabin seats a pilot and three passengers, and has an auxiliary seat for a fourth passenger.

Powering the jet will be two of the world's smallest turbofan engines, 12 inches in diameter and 31 inches long, and weighing only 141 pounds. Each will deliver 570 pounds of thrust. They're made by Williams Research Corp., Walled Lake, Mich.

The projected flight range of the Foxjet is 1400 miles at 39,000 feet, at a cruising speed of 330 mph. Its maximum speed is projected at 376 mph initially, with increases anticipated with engine growth and further development.

The Foxjet will be able to take off and land at almost any runway used by conventional small planes, says TTI. It will operate from sod and other soft airstrip surfaces because of its short takeoff run—about 1400 feet—and dual low-pressure tires that can accommodate soft, uneven surfaces. Fox claims it will have the lowest footprint pressure of any aircraft of its size and weight.

A self-propelled one-man towing system that weighs seven pounds is stored in the aircraft, eliminating the need for ground support. Mass production is set for 1979.—*Susan Bronson*

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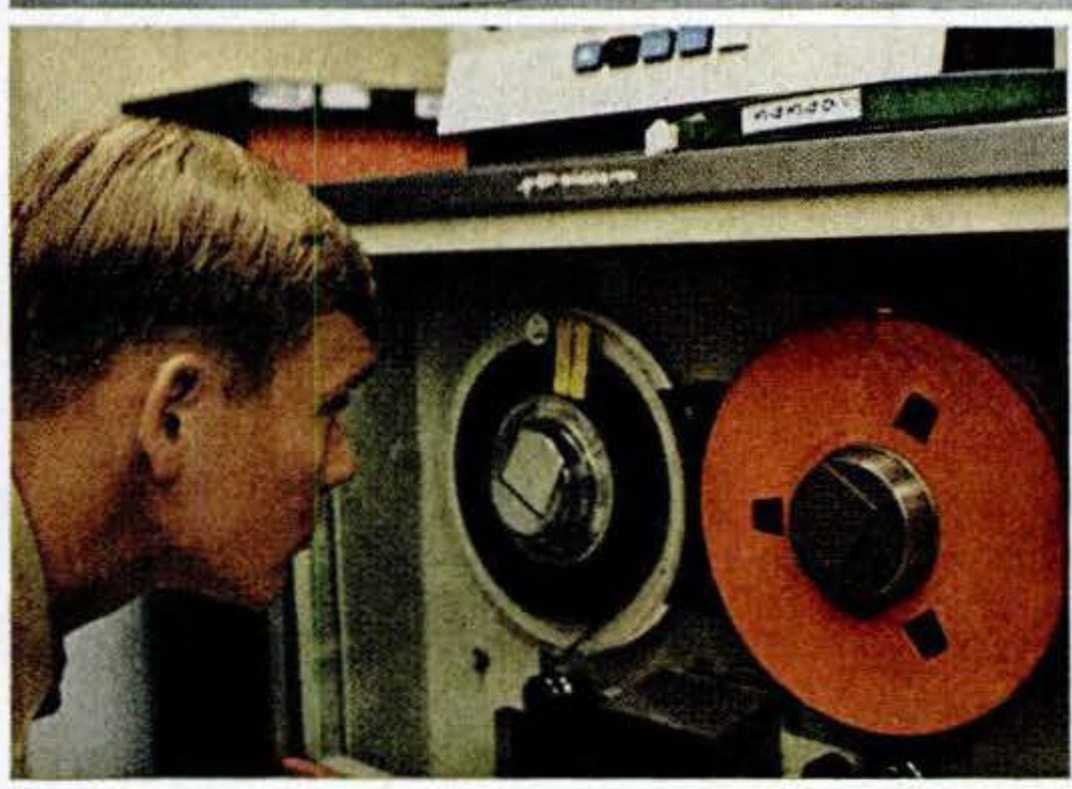

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Mothballing your outboard

—do it the easy way with these new products

New engines demand more attention and care—but now you've got help

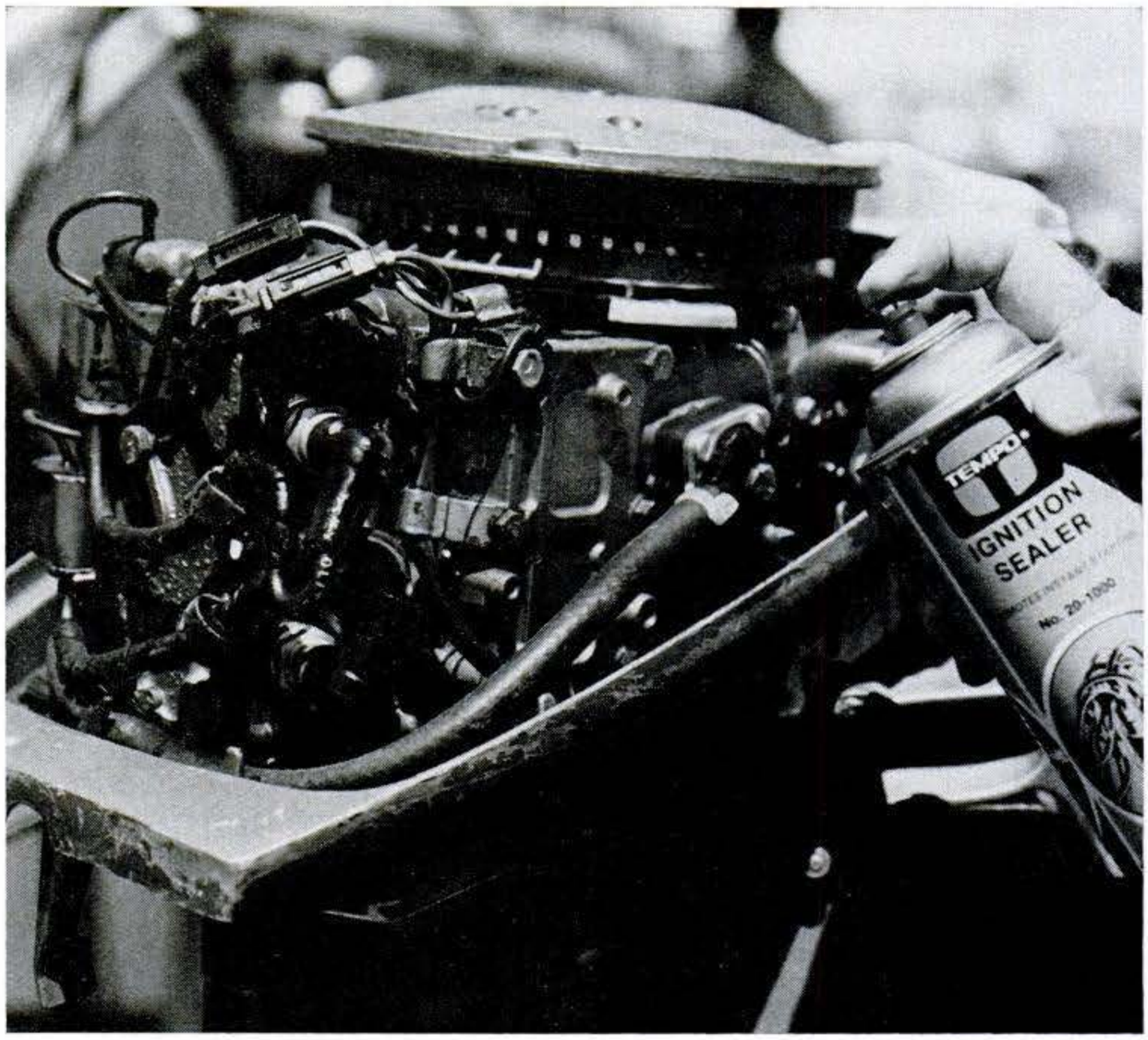
By BOB STEARNS

Outboard engines have become more sophisticated and expensive during the past decade, so it pays to give them the best possible care —even when you store them for the winter. Fortunately, it's a lot easier to mothball an outboard now than in the past, because there are specialized products that make the job simpler and offer superior protection.

Here's a checklist of critical engine components and the products you can use to protect them during winter storage.

• *Fuel system:* The standard procedure used to be to completely drain the gas tank and try to completely flush all fuel out of the gas lines and carburetor. Very often this was not successful, and damaging gum or "varnish" formed, requiring an expensive cleanout before the next season's operation. This is no longer necessary.

The best procedure is to fill the tank completely with gas, then add the required amount of a fuel stabilizer (sometimes called a fuel conditioner). Usually an ounce or two per gallon of gas will do the trick. Follow the manufacturer's instructions carefully. Do not add any additives not recommended by the manufacturer or specifically designed for outboard use. Many automotive gasoline additives can seriously damage your outboard. Some of the fuel stabilizers designed specifically for outboard use are 2+4 Fuel Conditioner (OMC) Fuel Aid (Chrysler), Sta-Bil (Knox Laboratories), and Dehydrin A (H.K. Scientific Industries).



Ignition sealer spray forms a plastic coating over all cables and electrical terminals, which prevents moisture from entering connections.

Fuel conditioners not only stabilize gasoline, which tends to decompose into gum and varnish, but also remove water accumulated in the tank during the previous boating season. In fact, these additives work so well as water removers that it's not a bad idea to treat your gas tank during the middle of the boating season as well. Gasoline treated with a stabilizer or conditioner is usually good for a year.

• *Internal power head:* Tolerances for internal components of recent outboards are very close and require careful protection when the engine will be sitting idle for long periods. The old method of removing the spark plugs and pouring motor oil into the cylinders is no longer reliable. Also, the oil it-

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self tends to thicken with time and by the following spring will likely cause a starting problem.

This doesn't occur when you use a fogging oil to preserve the engine for storage. The best procedure is to run the engine at idle speed (after adding the fuel conditioner) and spray the fogging oil into the carb air intakes until the engine stalls (or at least begins to emit lots of smoke from the exhaust). This not only coats all of the internal moving parts but also puts fuel conditioner in the gas lines and carburetor.

Some of the proven fogging oils for outboard use include Rust Preventative Fogging Oil (OMC), Storage Seal (Mercury Marine), and Storage Lubricant (Chrysler).

• *External power head and exhaust housing:* If the engine has accumulated a thick coating of grease on any exterior parts, it's a good idea to remove these deposits before they harden and begin to restrict the operation of moving parts such as throttle or gearshift linkages. If you've used the outboard around salt water or even chemically polluted fresh water, these grease deposits can trap salt or damaging chemicals in places where they can do lots of damage. Use an engine degreaser (OMC or Tempo Products Co. makes them) to remove unwanted grease accumulations.

Regrease with a good anti-corrosion grease, such as Quicksilver Anti-Corrosion Grease (Mercury Marine), Never-Seez (Never-Seez Compound Corp.), or Anti-Corrosion Lube (OMC). Don't overgrease; use just enough to ensure smooth operation of moving parts. Incidentally, those lubes are also ideal for regreasing the shaft.

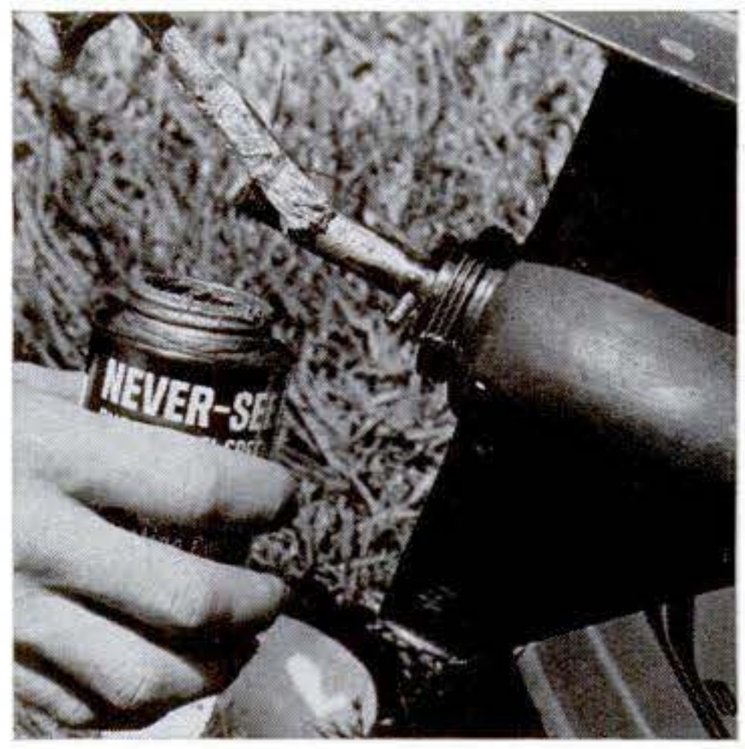
Once the external parts of the engine are clean and degreased, the remaining surfaces need additional protection. If there are crevices through which moisture can work its way into the ignition system (distributor caps where the wiring protrudes, spark-plug caps, grommets where wiring exits the magneto plate), a coating with a sealing spray such as Tempo's Ignition Sealer can be a big help.

The final step in external component protection is a thorough spraydown with a good moisture-displacing lubricant such as SS2 (Totally Dependable Prod. Inc.), Sea Lube (OMC), WD-40 (WD-40 Company), PDRP (Tempo Prod.), or CRC (either 5-56 or 6-66 by CRC Chemicals). Many other products, too numerous to mention, achieve similar results.

Engine degreaser sprayed on the power head removes chemicals and salt that can restrict operation of moving parts.

Fogging oil is introduced at the carburetor while the engine is at idle. Spray until engine stalls or emits smoke.

Foamy spray cleanser removes battery corrosion and buildup that could eventually drain and damage the cell.



Anti-corrosion grease can also be used to coat the propeller shaft. Stiff brush applicator gives smooth coating.

• *Cooling system:* If the engine is operated only in clean fresh water, nothing is required here. However, if it was used in salt water or fresh water containing industrial wastes, flush the engine with clean fresh water. Adding a few tablespoons of mild liquid dishwashing detergent to the container of water (or to the hose before connecting the flush attachment) will facilitate the complete removal of unwanted chemical deposits within the cooling system.

• *Electrical battery system:* If your outboard uses a lead-acid storage battery for starting and/or ignition operation, it almost certainly won't be serviceable in spring unless you prepare it for storage. Usually, by the end of the boating season the battery and connecting wiring harness are coated with dirt, acid residue (from the battery itself), and salt or chemicals from the water. If not removed, this coating will corrode terminals and wiring connectors, and completely discharge the battery (if its voltage drops below 8V or 9V, irreversible internal damage is likely).

Clean the battery and wiring harness completely with soap and water or a commercial battery cleaner such as Battery Cleaner by Tempo Products. Make sure all corrosion is removed from the terminals and wiring connectors. Then spray the whole works with one of the moisture-displacing lubricants mentioned earlier, or a battery protector. Finally, disconnect all wiring, charge the battery completely, and store it in a dry location. Incidentally, the higher the state of charge, the more resistant the battery is to severe cold-weather damage. It's also a good idea to recharge at two-to-three-month intervals. PS

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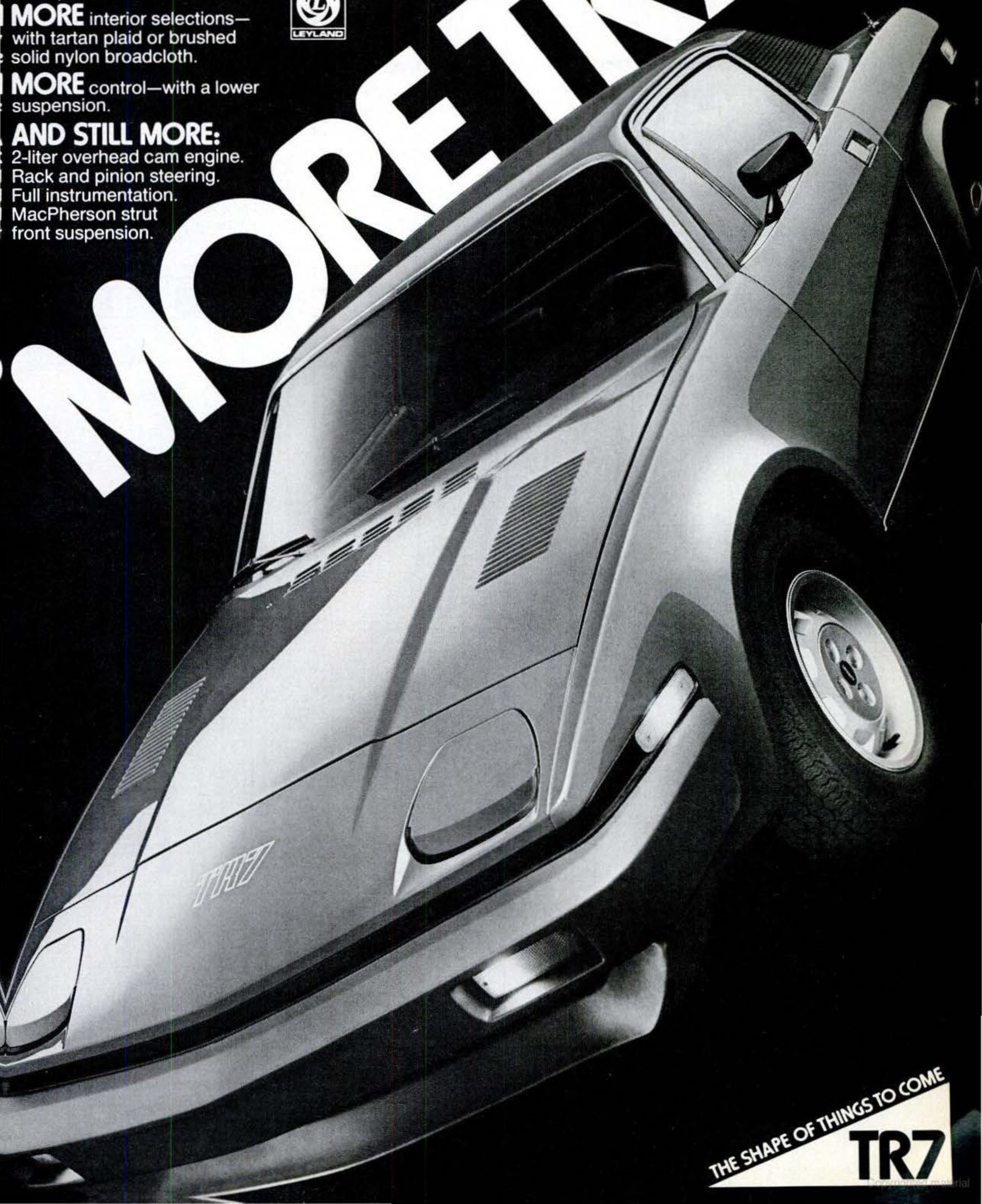

THE SHAPE OF THINGS TO COME
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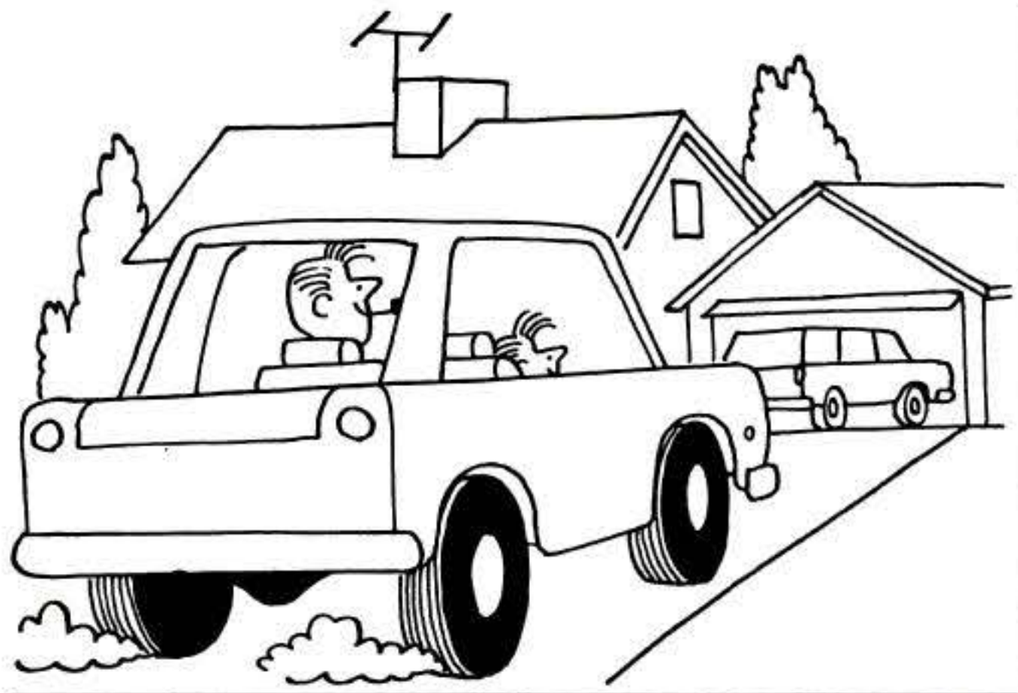
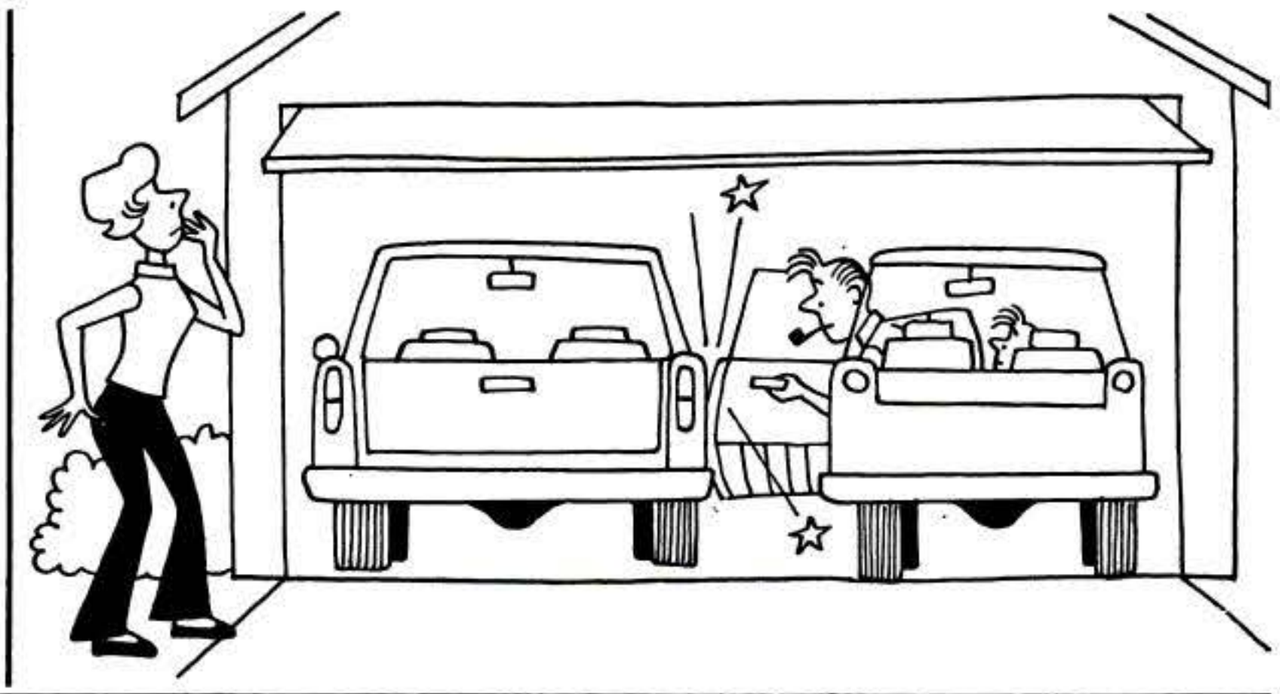
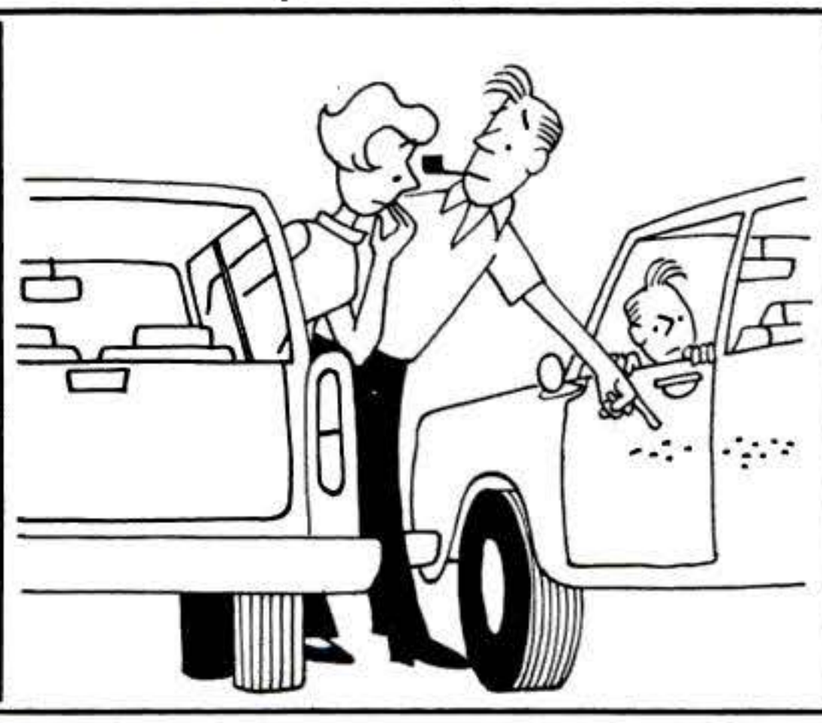
WORDLESS WORKSHOP

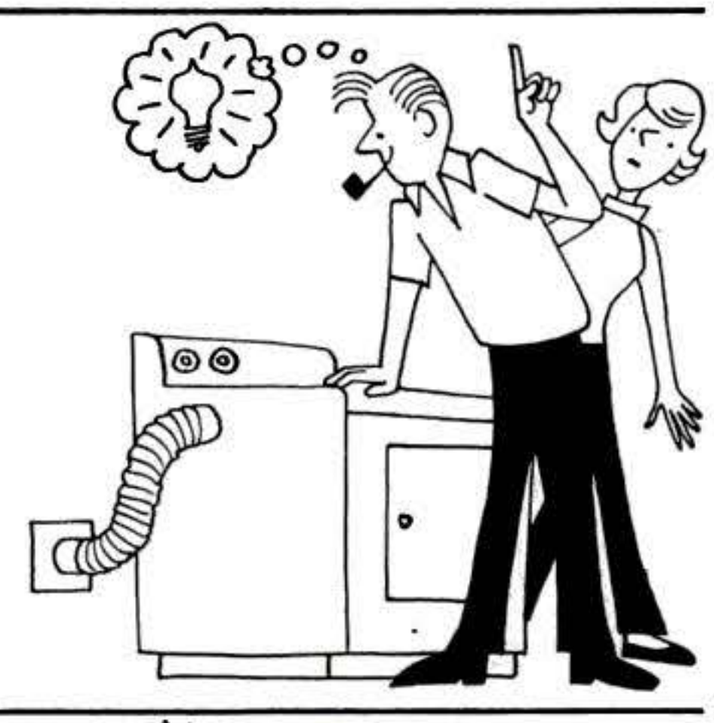
By ROY DOTY

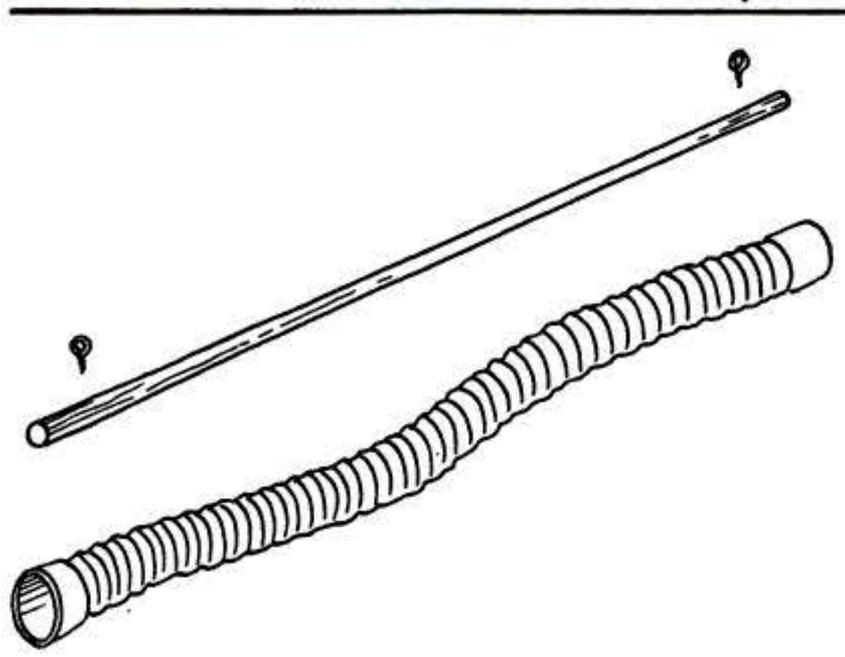
$25 to John Zirngibl of Milwaukee for idea from which this was adapted. Send yours (with Social Security No.) to Wordless, Popular Science, 380 Madison Ave., New York, N.Y. 10017. Only purchased ideas acknowledged.

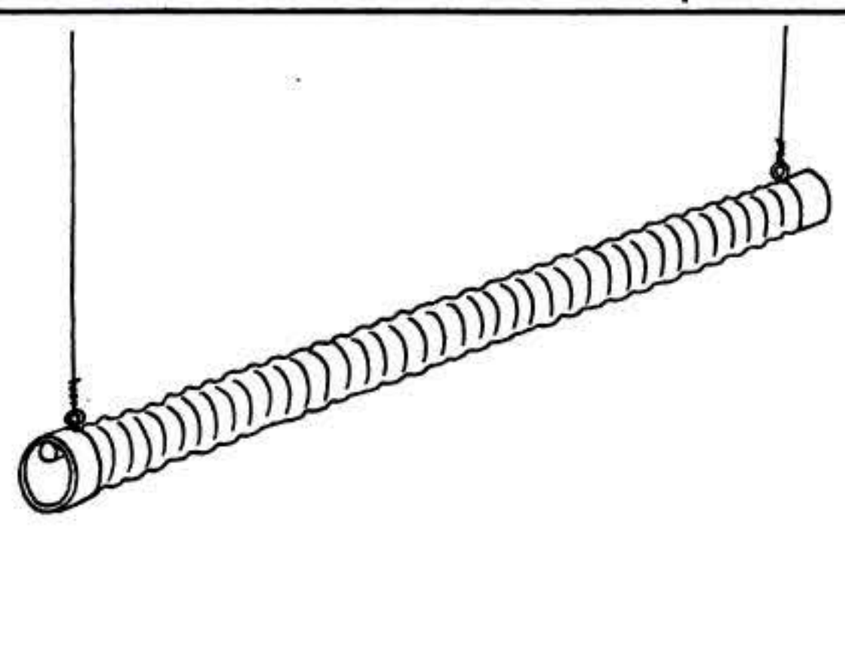


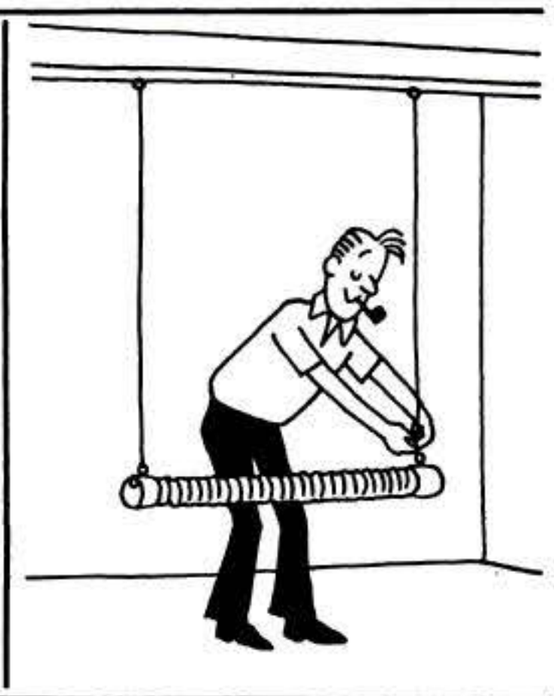


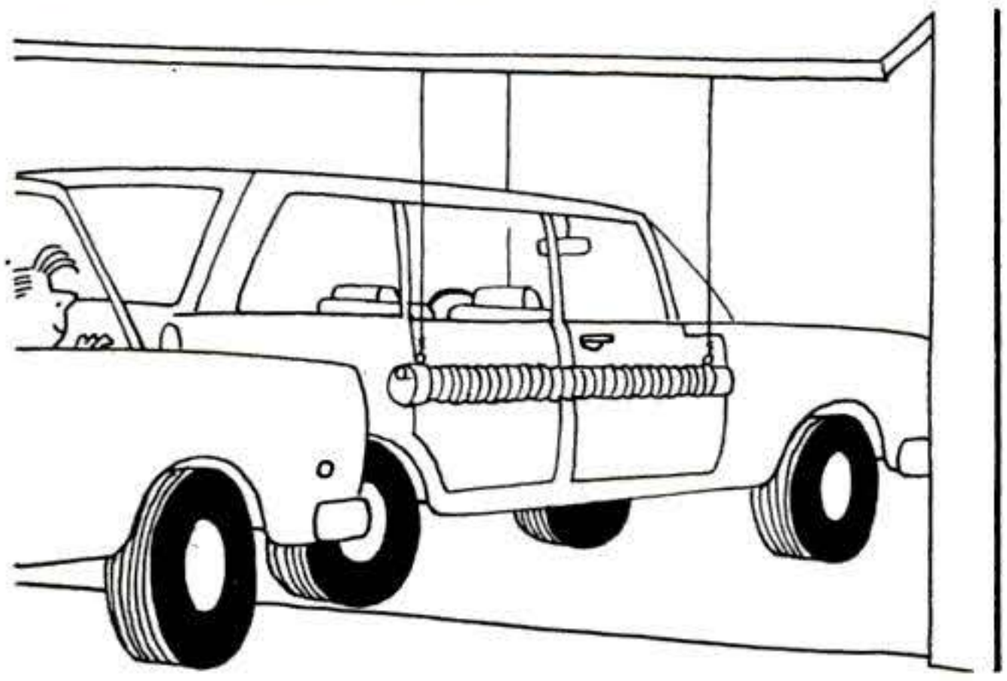


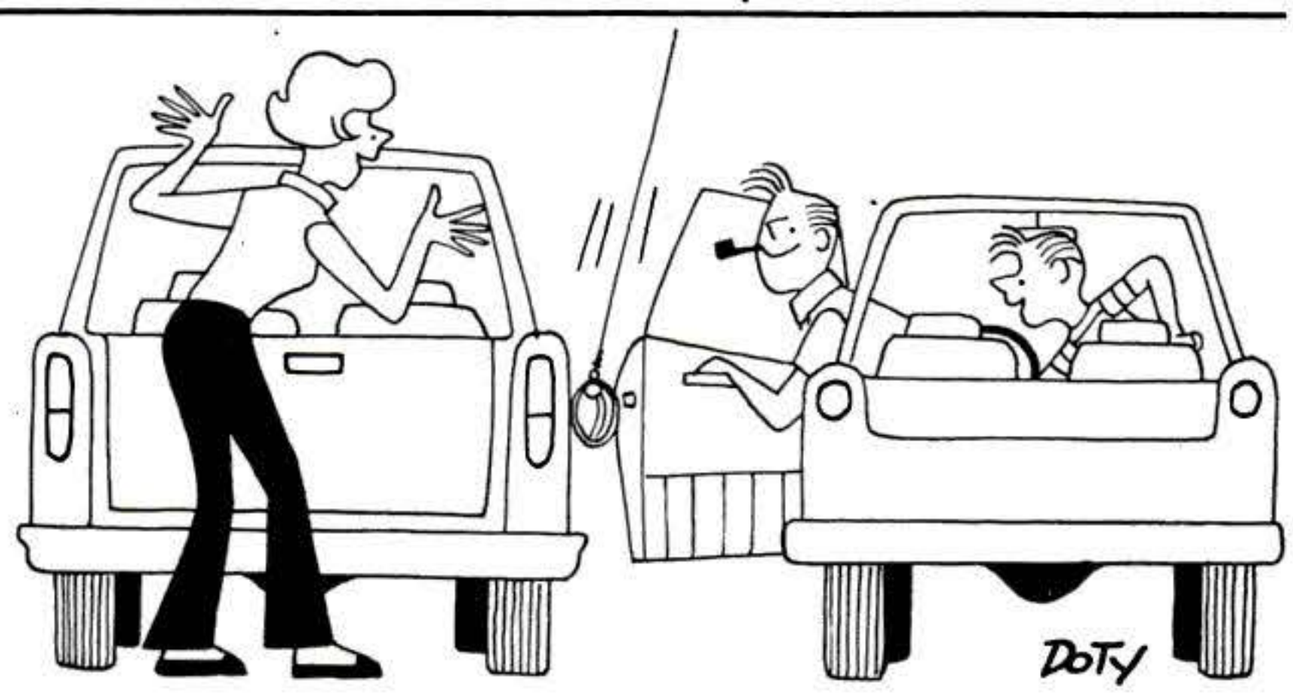












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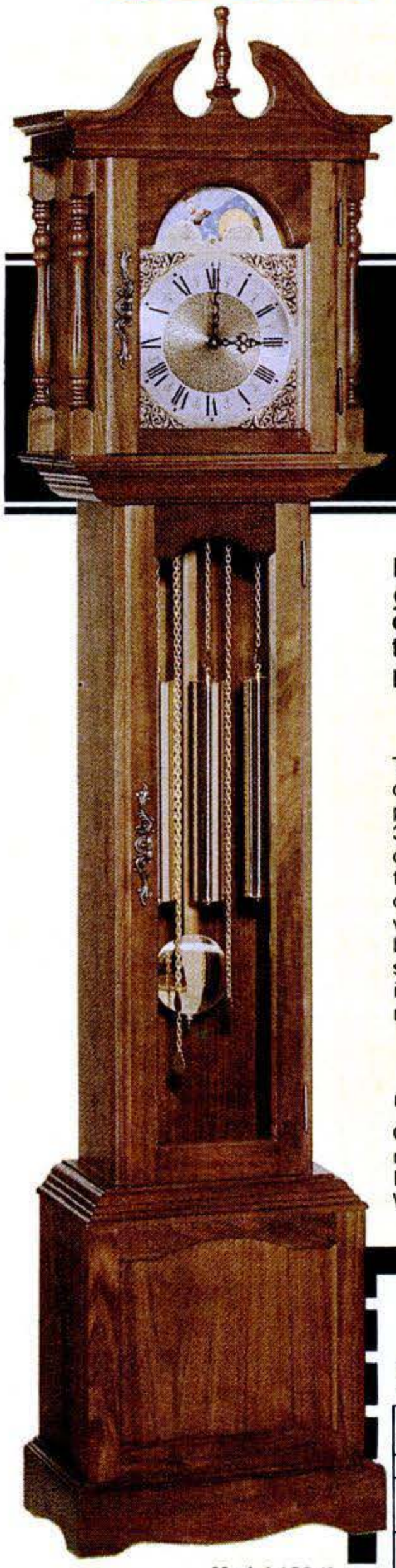

EMPEROR'S MODEL 120-K DO-IT-YOURSELF CASE KIT

SOLID 3/4" BLACK WALNUT

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Or, case kit alone $114.50
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COMPARE YOUR FINISHED CLOCK WITH THOSE RETAILING UP TO $850.

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Build your own Emperor grandfather clock! The saving is great because you buy direct from the factory of the world's largest manufacturer of grandfather clock case kits. . . no middlemen, no salesmen. And if you order today, during this limited-time sale, you can build Model 120-K at a cost below our regular factory direct price.

MODEL 120-K IS PRE-CUT, EASY TO DO

The doing is easy with Emperor's Model 120-K. It comes to you in easy-to-assemble kit form, with all pieces completely pre-cut from highly-prized solid 3/4" black walnut. All kit pieces pre-sanded smooth on all sides for accurate fit. All miters, mortises and tenons pre-cut. (For those who prefer, kits may be ordered unmitered.) Divided swan neck and finial, waist and dial face doors, dial frame and sculptured basefront pre-assembled. Complete assembly instructions and all hardware included. No woodworking experience or special tools needed. Each piece may be reordered separately.

DETAILS AND FEATURES OF MODEL 120

- Stands a full 6'2" tall
- Four full-turned hood columns
- All frames dowel constructed
- Built-in floor levelers
- Deluxe brass-finished hardware and more

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If for any reason you are not completely satisfied, return in original shipping carton within thirty days for prompt refund. . . no questions, no excuses.

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Made in West Germany of Solid Brass

EIGHT DAY • WEIGHT DRIVEN • WESTMINSTER CHIMES

Choose from two dial versions of Emperor's 100-M movement: Tempus Fugit (Time Flies) or Moving Moon with lunar calendar. Both versions sound the Westminster chimes each quarter-hour and a Big Ben tone on the hour. Movement includes weights, solid brass weight shells, brass bob, pendulum and chimes. All plates are solid brass and pinions hardened steel. Installation and adjustment is simple, following step-by-step instructions.

MOVEMENT CARRIES A ONE YEAR WARRANTY

Model 120-K
Solid 3/4" Black Walnut
74" x 16-3/4" x 10"

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QTY.	ITEM NO.	DESCRIPTION	WT.	FACTORY DIRECT REG. PRICE	FACTORY DIRECT SALE	EXTENSION
	13041	Please send kit unmitered ☐				
	13238	Model 120-K Solid 3/4" Black Walnut Do-It-Yourself Case Kit with purchase of either movement (priced separately below)	49	$149.50	$104 50	
	13238	Model 120-K Solid 3/4" Black Walnut Do-It-Yourself Case Kit without purchase of movement (priced separately below)	49	$149.50	$114 50	
	11463	Model 100-M Movement complete with Tempus Fugit Dial, Westminster Chimes for Model 120-K	33	$119.50		
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Homeowner Tips

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It's Incredible What This Formula Can Do. CRC Lubricates, Stops Rust, Cleans, Loosens Rusted Parts, Protects Metal. Starts Wet Engines. Makes Things Work Smoothly Again.

TOOL PROTECTOR!
SPRAY CRC ON ALL TOOLS FOR LONG LASTING RUST PROTECTION. LUBRICATES TOO. BETTER THAN ORDINARY HOUSEHOLD OIL!

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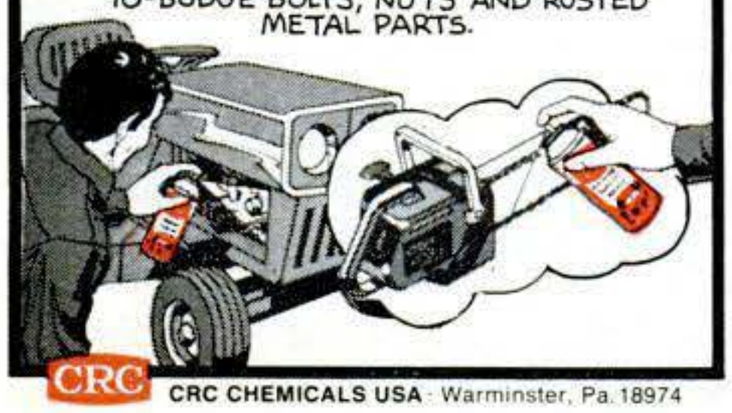
CRC IS AN INDESPENSIBLE "TOOL" FOR PROTECTING ALL OUTDOOR-USE EQUIP...LIKE LAWN MOWERS, SHEARS, CHAIN SAWS, CLIPPERS. CRC'S PENETRATING ACTION QUICKLY FREES HARD-TO-BUDGE BOLTS, NUTS AND RUSTED METAL PARTS.



CRC CHEMICALS USA · Warminster, Pa. 18974

Unicorn will split about a cord an hour on about a gallon of gas. Here author feeds it a chunk of white oak. Note safety shutoff switch just above wheel well.

Log splitter

runs off your car or tractor engine

I believe in Unicorns. And so will you after you've seen one quietly chew its way through a cord of firewood in a little over an hour.

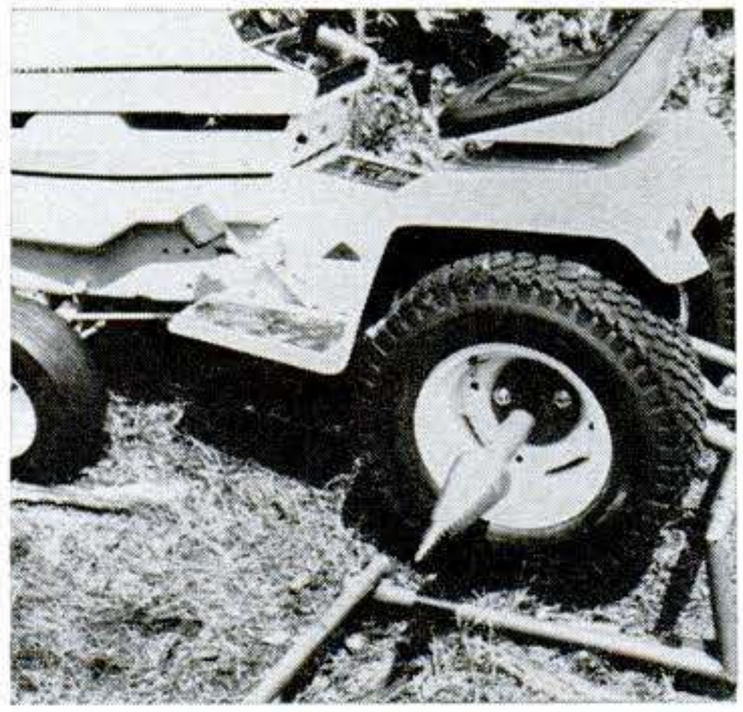
The Unicorn is a new type of log splitter. It's a big fat screw that bolts to the rear wheel of your car or truck. With that wheel jacked up off the ground, and with your car idling along in second gear, the screw quickly digs its way into a log and splits it in half.

In many ways the Unicorn is similar to the Stickler log splitter [PS, March]. But the Unicorn is the original and patented version. It has a machined screw that is tougher than the cast screw on the Stickler. The screw has coarser, higher pitched threads that work at lower rpm. The Unicorn has a special stand to support the axle of your car. And it can be used with the car's tire in place. That's an advantage if you want to move your splitting operation quickly.

The Unicorn is a joy to use. At first that big screw is intimidating, spinning away like a rogue hubcap. But you soon get used to it. You begin to appreciate how fast, quiet, and safe it is. The Unicorn has an emergency shutoff switch, but I've never had to use it. I'm convinced this tool is safer than other types of splitters, and that includes the old-fashioned sledge and wedge.

Unicorns come in a variety of models. The basic Mark I fits most cars and trucks except subcompacts and some trucks over 1½ tons. It costs $299. The Mark G ($289) fits most big garden tractors. The Mark G2 ($249) fits Gravely tractors. There are two other models designed for farm tractor PTO's.

The Unicorn Log Splitter is made by the Thackery Co., 1879 Frebis Ave., Columbus, Ohio 43206.—*A. J. Hand*



Most large garden tractors will take the Unicorn Mark G. Included are Simplicity, Jacobsen, Ford, AMF, Bolens, Case, John Deere, IH and Wheel Horse.

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but the real news is Economy.

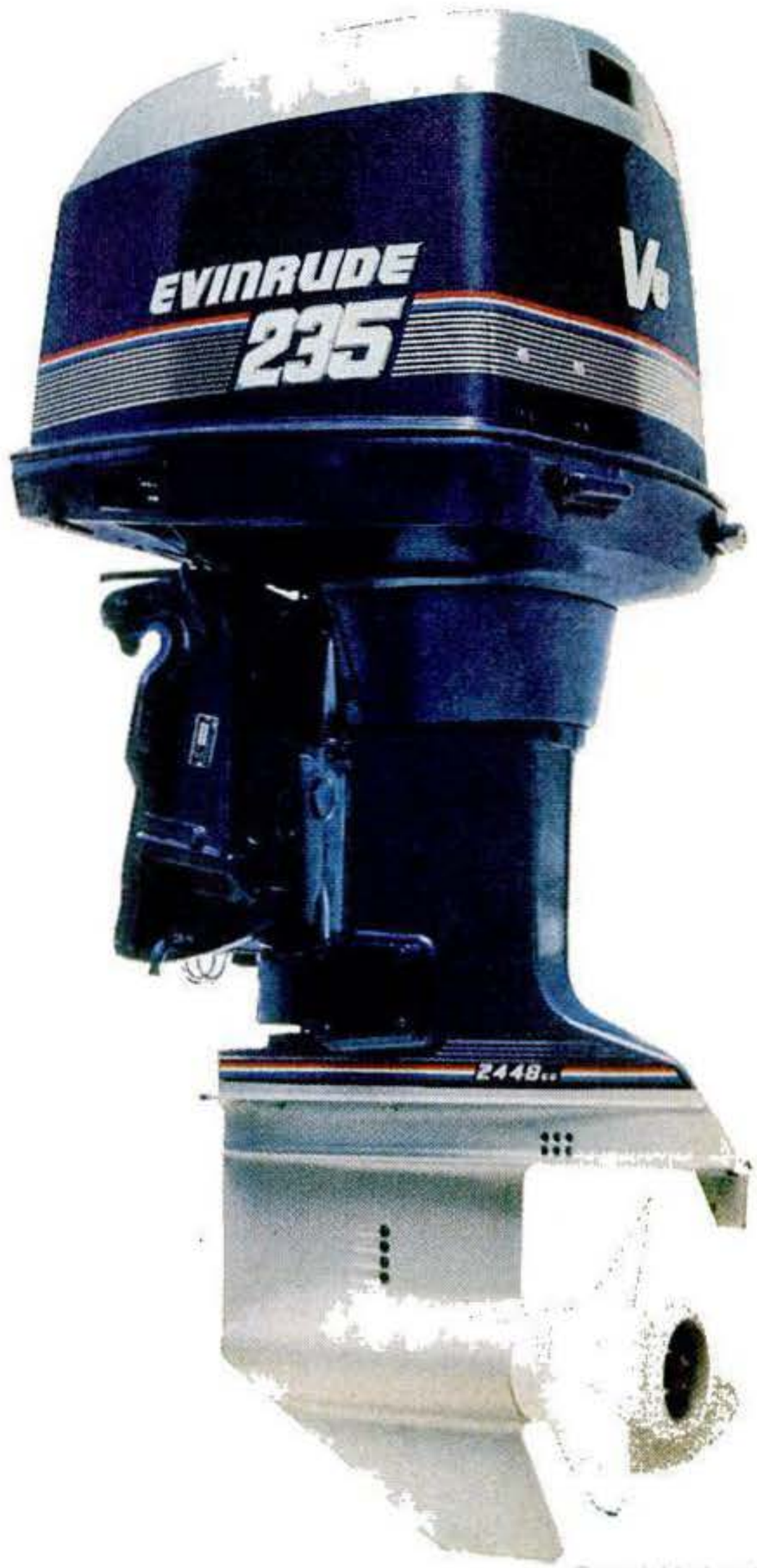
Consider that all this power comes from a highly efficient V-6 Evinrude in the displacement class of a 4 cylinder Pinto or Vega.

A tough, compact, salt-water-engineered outboard V-6—with outboard reliability and cost—that delivers the power and performance of a 350 cu. in. inboard V-8. And cruises, with its new Power Step carburetion, on small-orifice jets at bottom fuel dollar.

It's the first real outboard alternative to offshore inboard power. For big boats and big water, it's the new *economy* way to go.

—AND THAT'S JUST FOR OPENERS
For 1978, we've added new high speed handling to our 140; advanced Firepower II electronic ignition to every Evinrude from 4-235 hp; the Little Squirt water pump indicator to all gearshift Evinrudes; and improvements and refinements all along the line. See your Evinrude dealer for a preview.

UNDER OUTBOARD MOTORS



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Master MECHANIC™ Combination Tool Chest

Heavy-duty pair designed for big tool organization jobs. Chest has 6 drawers that lock when lid closes. 26x15x13½" overall. 1806 . . **69.99**
3-drawer cabinet has lower storage, rolls on 4" casters, recessed top holds chest. 1903 . . . . **79.99**

USM Pro-Quality Fasteners

"Pop" Rivetool has interchangeable nosepieces to set ⅛" and 3/16" rivets. K110 . . . . . **4.95**
Thermogrip® electric glue gun has thermostat, trigger control. No waiting to dry. 207 . . . . . **8.95**

Master MECHANIC™ Propane Torch

Instant adjustable heat to thaw pipes, re paint, lay tile, dozens of uses. 26.7-oz. inder with all-brass burner assembly. UL listed. TT-555 **5.7**

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Rockwell International Power Tools

A 10" Homecraft® Saw turns out 5000 rpm, cuts 3¼" at 90°, 2⅛" at 45°. With stand and extensions, self-aligning rip fence, mitre gauge, table insert, guide bars, wrenches, free combination and dado blades. 2½ hp motor. 34-665. . . . . **239.99**

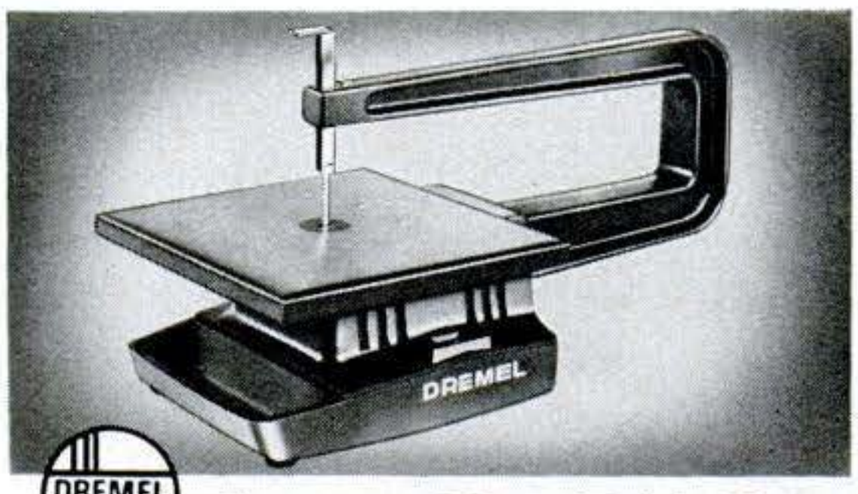
B 2-speed Jig Saw cuts wood, metals, plastics and composition. Base insert prevents splitting. Ball Bearing Orbital Sander sands flush along verticals. Dual handles give positive control. 10,000 opm. **Your Choice, each. 18.88**

SKIL® Cordless ⅜" Drill

Use this ⅜" drill anywhere, recharge it overnight. Two-speed forward-reverse action drives and removes screws. Hi-torque, low rpm. With recharger. 2002-T3 **29.99**

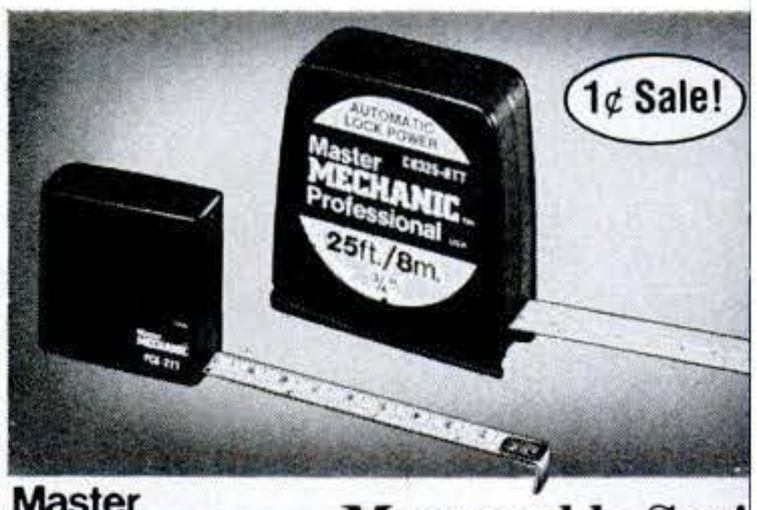
SKIL® Versatile X-tra T

Includes accessories to drill, hammer-drive and remove screws, scrape, chisel gouge. Adjustable speed, forward and reverse. ⅓ hp. 599 **49.9**



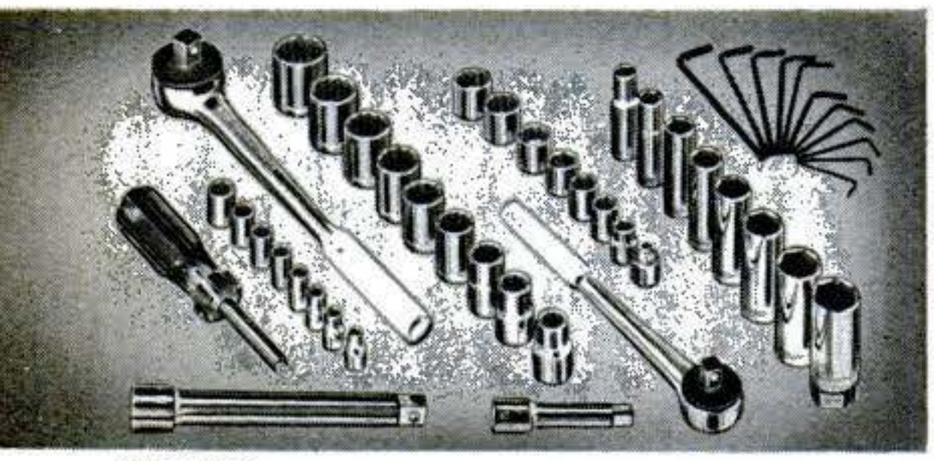
DREMEL Compact Moto Table Saw

A mini-workshop for hobbies and woodworking, sets up in 8x18" space. 15" jig saw cuts wood up to 2" thick. Includes safety blade guard and 2 blades. 550 **33.95**



Master MECHANIC™ Measurable Savi

Buy the big 25-ft. steel tape rule with matic power-return and lock-in-place for 5.75. Get a handy 6-ft. mini tape for 1¢. **Both only** **5.**

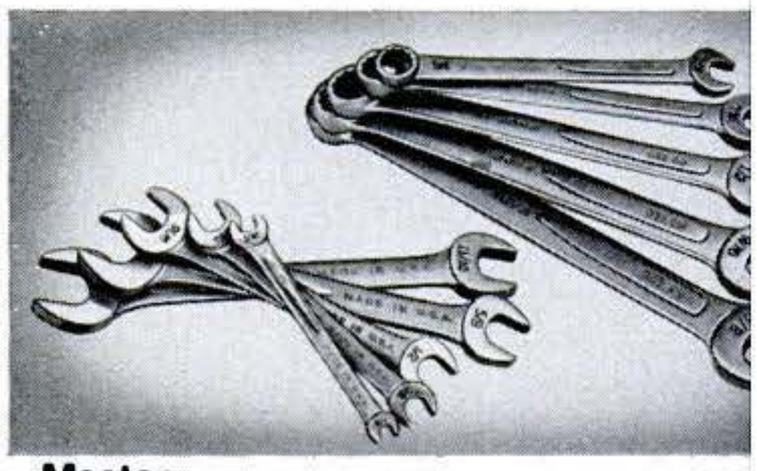


Master MECHANIC™ Steel Socket Set

49-pc. set has ¼", ⅜" and ½" drive sockets plus spinner, adapters, reversible ratchets, extensions, spark plug sockets, hex key set and much more. T3749 **44.44**

Master MECHANIC™ 17-pc. Socket Sets

Standard or metric set. Each has 11 sockets plus reducing adapter, spinner adapter, extension, spark plug socket, ratchet, and fitted case. **Your Choice** **18.88**



Master MECHANIC™ Steel Wrench S

Choose 5-pc. combination wrench set, wit and open-end sizes ⅜"-⅝". Or the 5-pc. end set with 10 sizes from ¼"-13/16". **Your Choice, each** **8.8**

COTTER & COMPANY, 100% Member-Owned warehouse distributor serving over 5000 True Value Hardware Members who own their own stores, set their prices and reserve the right to limit quantities.

OMELITE 10" Chain Saw

s trees up to 20" dia., weighs only 7¼ lbs. ck-starting, all-weather ignition, automatic ng. Saf-T-Tip™ pre- ts kickback. XL10 **79.95**

Master **MECHANIC**™ Single-Bit Steel Ax

Well-balanced at 3½ lbs. Light enough for effortless use, heavy enough to bite deep. Drop forged and hand ground to hold a sharp edge. Hickory handle. 35SBTT **7.49**

Master **MECHANIC**™

Wet'n Dry Vac

Power to pick up water and debris from fireplace, basement, shop or garage. 7¼ gal. dry cap., 6¼ gal. wet. With accessories. TT-650-1

44.95

TOOL VALUES

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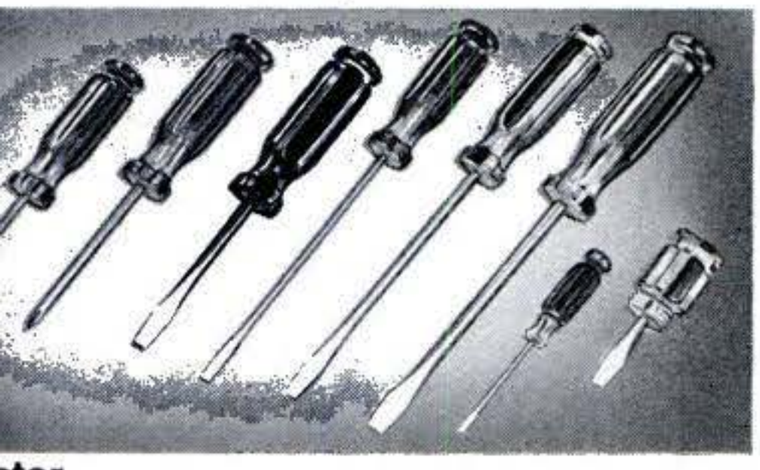
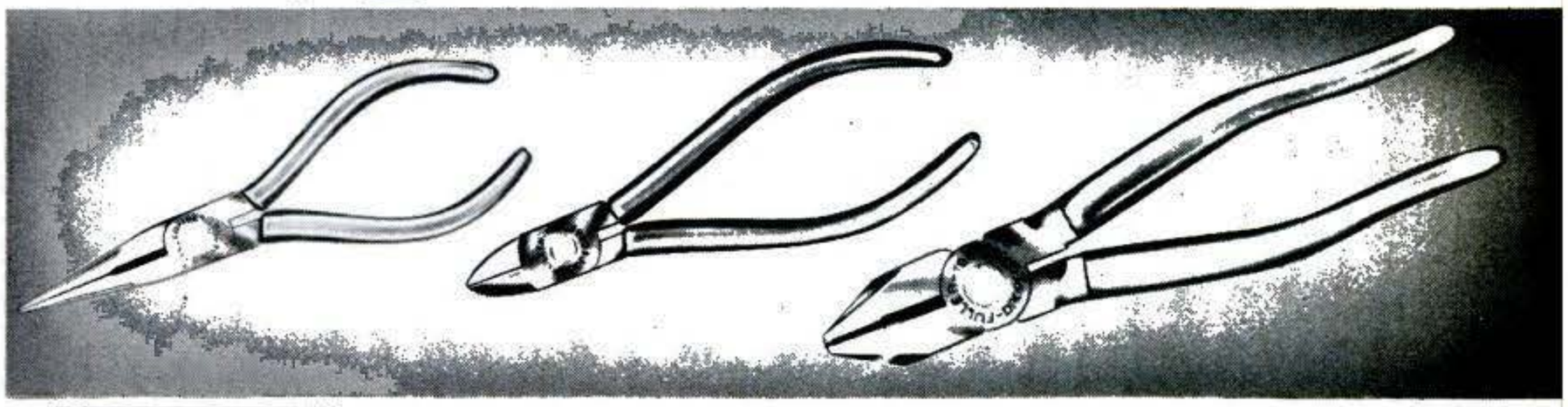


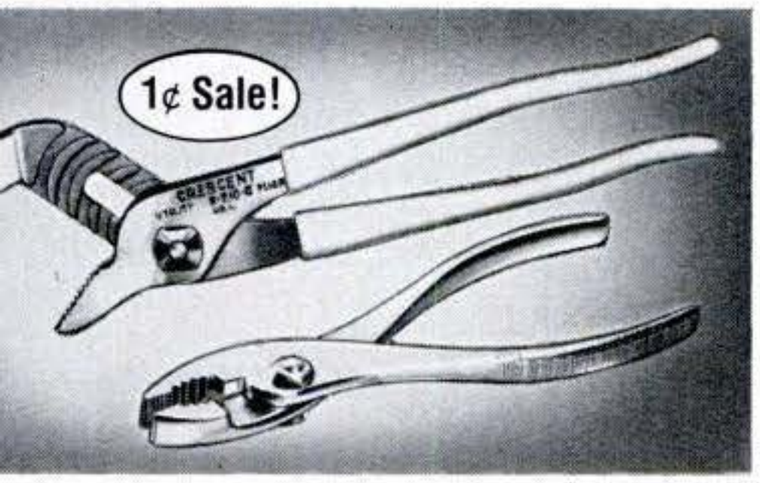
ster **ECHANIC**™ Screwdriver Set

set gives you a screwdriver for every including phillips and mechanics' round le. Long-wearing cross- und tips, with pouch. TT8 **4.25**



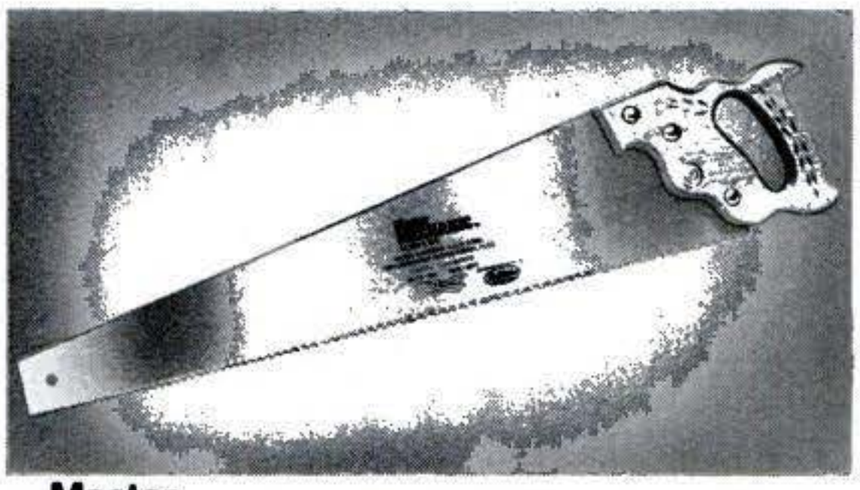
FULLER Outstanding Values in Famous Quality Pliers

Fill out your tool box needs now, at one low price on these Fuller pliers. All are drop forged tool steel, furnace hardened and oil tempered for long wear, with rust-proof polished finish. "Live action" vinyl-covered handles add power to your grip. Choose 6½" long-nose pliers, 6" diagonal-cut pliers or 7" lineman pliers. **Your Choice, each** **2.99**



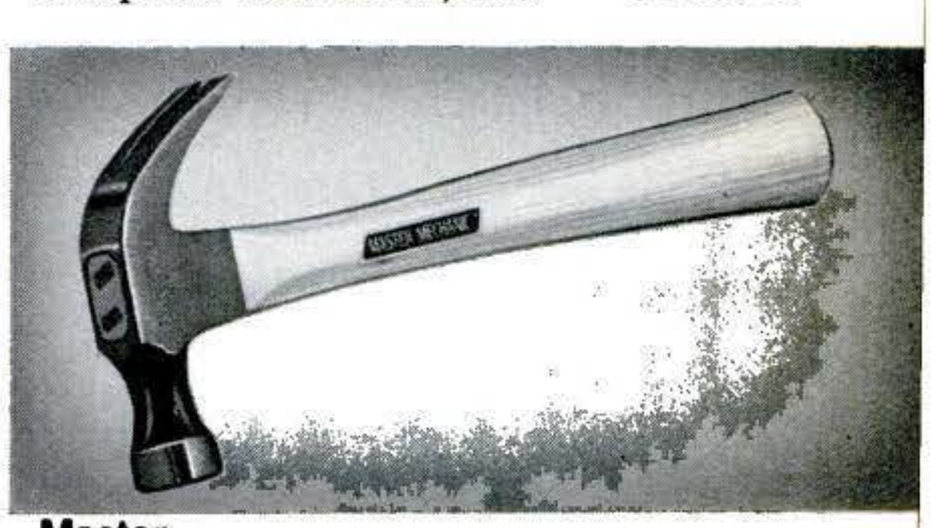
ESCENT® Plier Combination

Multi-Plier with 5-position adjustable jaw, ns to 1½" and locks in place, only 4.74. the 6" slip-joint steel r for 1¢. **Both only** **4.75**



Master **MECHANIC**™ 26-in. Rip Saw

Hardened chromium alloy steel blade promises years of dependable service. 8 points per inch, rips through hard or soft wood and plywood. TT128 **5.95**



Master **MECHANIC**™ Claw Hammer

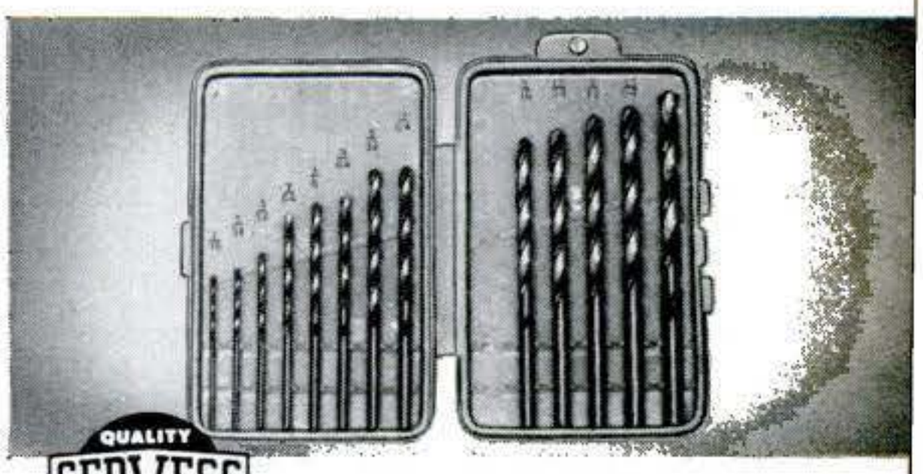
16-oz. hammer has hardened, tempered steel head, fully polished face. Tru-Seal bonded to octagon hickory handle for lasting fit. B16TT **4.75**

ter **ECHANIC**™ 2-Pak Saw Blades

cision ground chrome nickel alloy steel, proof chromate finish. 1 combination rip e, 1 smooth-cutting plywood de. 7¼" size. **Both only** **4.95**

Master **MECHANIC**™ Tap and Die Set

Chromed steel with sharp, clean-cutting edges. 12-pc. set includes five 1" solid dies, five taps, die stock and tap wrench. For coarse or fine cuts. TD12 **9.99**



QUALITY SERVESS PRODUCTS High-Speed Drill Set

13 precision-turned bits with hardened points give long wear through wood or metal. Sizes 1/16"-¼", in fitted carry case. To fit all electric drills. S13 **4.50**

pating True Value Hardware Stores vary in size and merchandising policies, some may not stock all items shown. Prices may vary and are subject to change without notice. Prices expire Nov. 12, 1977.

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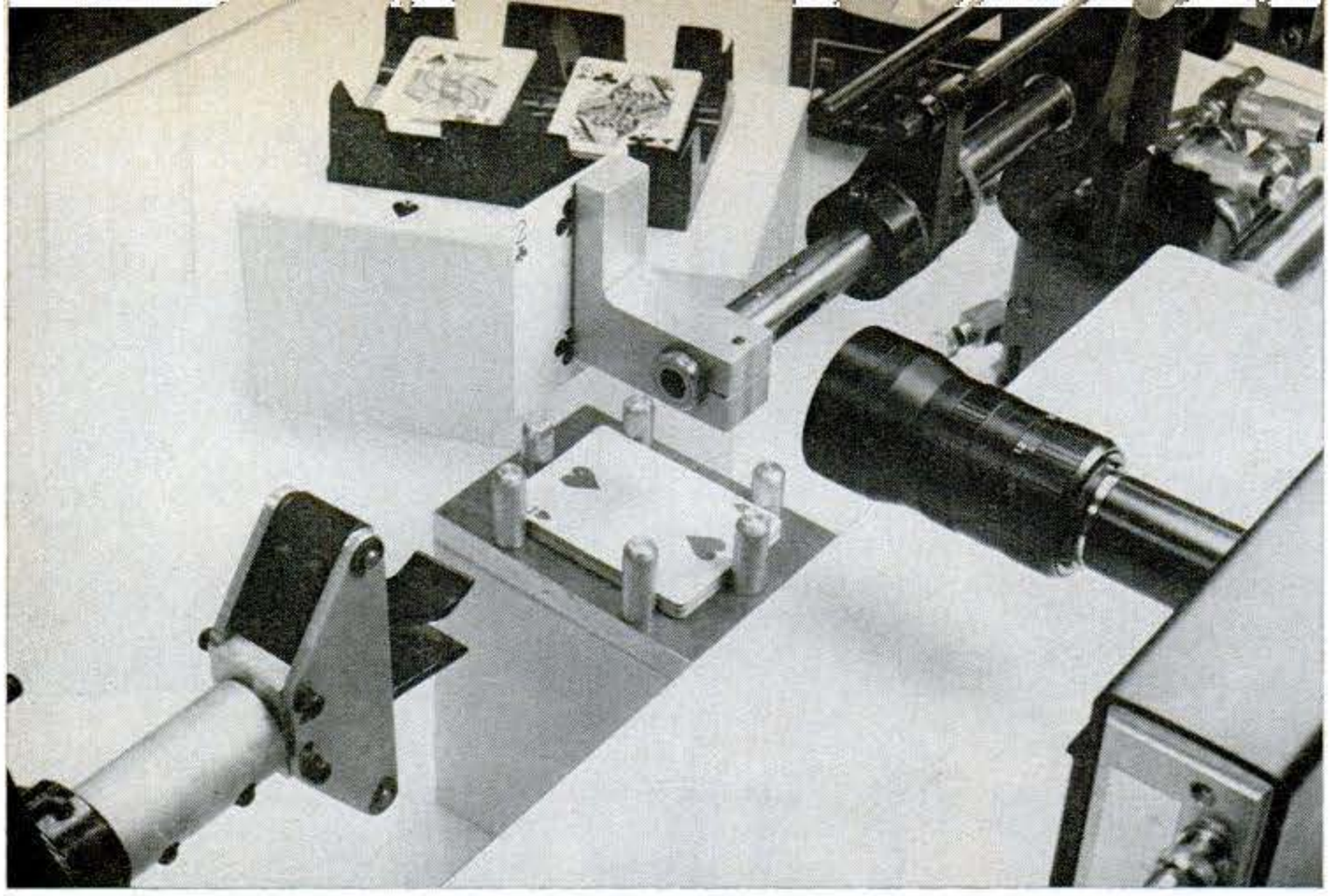

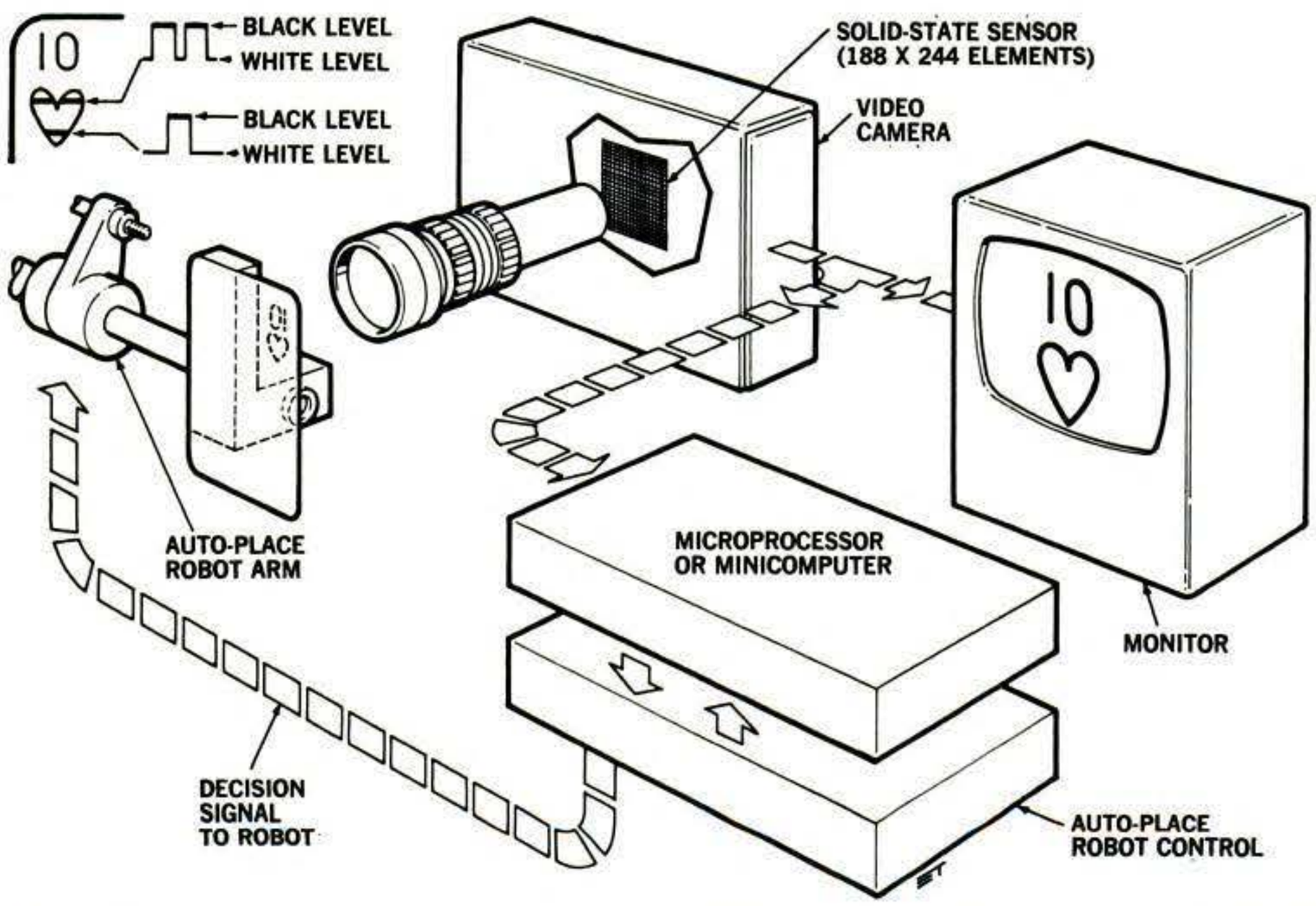

Sorting cards is easy for Auto-Place's Opto-Sense video robot. On an assembly line, the TV-eye machine might work harder. The camera contains a G.E. solid-state sensor with 45,872 elements. The output of each sensor row varies as elements are electronically scanned, depending on the image striking the array. A computer, recognizing the output, can actuate the robot arm.

Opto-Sense
–TV eye for industrial robots

Mechanical arms and other automated industrial tools that once groped blindly with programmed commands can now see what they're doing. By linking a General Electric video camera with digital-processing circuits, Auto-Place, Inc., is producing robots that can recognize when an assembly-line part is missing, broken, or oriented the wrong way.

In the card-sorting task pictured, the video camera scans row by row down the microscopic elements on its postage-stamp-size sensor. Each picture element senses whether it sees black or white. The amount of time the camera sees black is compared with known values for each card suit stored in an electronic memory. Since the black areas for the heart and club pips are almost identical, the Opto-Sense must measure how rapidly the area of the heart pip changes from top to bottom. Output signals from a computer are converted to air signals through solenoid valves, pneumatically moving the robot arms.

So far, Opto-Sense can't perform the complex coordination between its arms and "brain" that human beings are capable of. But higher-resolution "eyes" and more sophisticated computers may soon change that.—*John Free*

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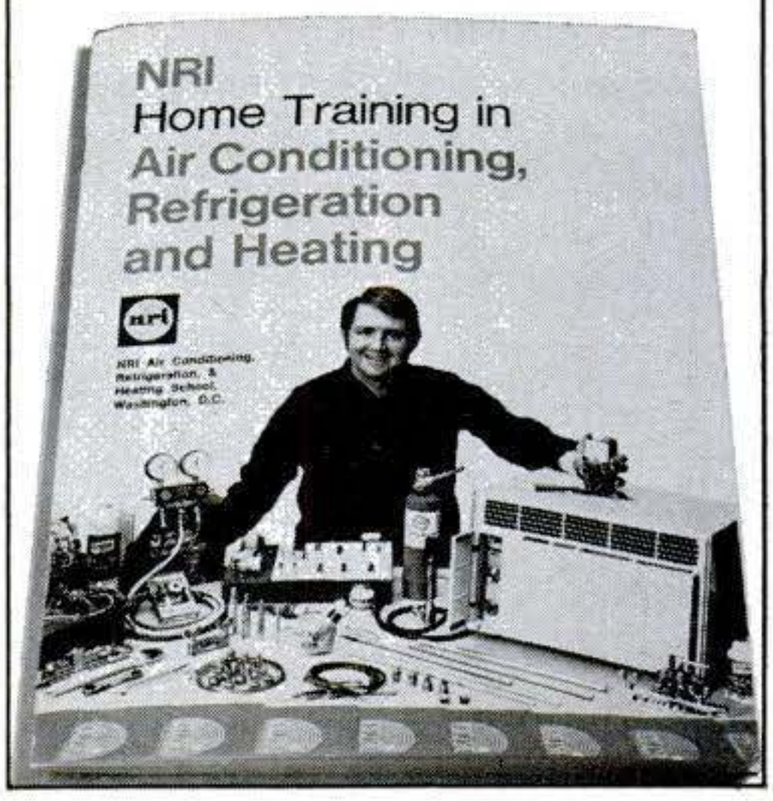

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Where do the pros get their training?

Almost half of the successful TV servicemen have home study training, and among them, it's NRI 2 to 1! A national survey* performed by an independent research organization showed that pros named NRI most often as the recommended school and as the first choice by far among those who had taken home study courses from any school.

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*Summary of survey results on request.

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DETROIT REPORT

By JIM DUNNE

Son of Riviera

A new Riviera model that offers much of the flair of the original car is set for introduction in 1979. Biggest differences include a smaller body and front-wheel drive. It will use a smaller engine, but keep the same performance level as today's Riviera. Its front-drive system will be shared by Eldorado and Toronado. All three cars will be completely redesigned, and have a miniaturized front-drive mechanism very similar to the present Toronado's. Styling will not be as impressive as the earlier Rivieras—it will be a mixture of that of the present car and of the 1978 Regal. Prototypes now under tests have independent rear suspension, rather than the bar axle of current GM front-drive cars.

Small cars are not dangerous

The laws of physics predict that in a two-car collision, the smaller vehicle will sustain the most damage. But a recently completed study of 1000 cars in accidents in Texas concludes that smaller cars don't really have a higher frequency of serious or fatal injury than larger ones. And in California, where 40 percent of car sales are imports—small cars—traffic fatalities were down 22 percent in 1974 and 16 percent in 1975. That state's fatality rate of 3.1 per 100 million miles is better than the national average of 3.61. Conclusion: Cars are not unsafe simply because they are small.

Two cars, one driver

General Motors has rigged up a system in which a car with a driver can be followed by a driverless car that duplicates all the maneuvers of the first car. The second car is operated by electrical servos that control throttle, brake, and steering. An aluminum boom, which imposes zero forces on the second car, holds the electrical cables needed to transfer signals between cars. The second car trails the lead car by about one car length around closed test courses on GM's proving grounds. The setup takes up less room on the tracks because the cars operate about 18 feet apart. Other advantages include a lower cost of testing, and a better correlation between cars in the same test cycle—what the first car does, the second imitates precisely.

Who buys Corvettes?

Nine times out of 10 the buyer is a male. He's 30 years old, earns about $23,000 a year, and is more than likely married (57 percent are). In comparison, the average age of all new-car buyers is 40, while the income and education levels are well below those of the Corvette owner. The list of primary reasons for choosing a Corvette is topped by exterior styling; then come open-road performance, resale, and handling. Price and fuel economy are down at the bottom. A study of Corvette owners conducted by Chevrolet also shows that the trend in automatic-transmission use has undergone wide swings. When first introduced in 1953, 100 percent of Corvettes had automatics. The installations fell off sharply to a low point in the 1965 model year when only 10 percent were automatics. Since then the trend has reversed; about 70 percent of buyers now order the automatic.

Restyled Mustang and Pinto

Ford plans to introduce restyled small cars beginning in the 1979 model year. First out will be a Mustang/Capri model. Styling will lean toward sharper lines, and include lower belt lines, more glass, rectangular headlights, and a tidier overall look. Pintos will bear a slight resemblance to the present Pinto/Bobcat line, but will feature larger rear side windows, lower belt lines, more glass, and wraparound taillights. Plastic bumpers are slated for the Mustang/Capri, but aluminum ones are retained on the Pinto/Bobcat. Though Mustang and Capri are essentially the same model, one for Ford, the other for Mercury, they will have different front-end appearance and trim.

Ford bets on PROCO

While its competitors are developing diesel engines, Ford Motor is putting its chips on the PROCO engine design [PS, July '75] that it's been developing for almost a decade. Better control of fuel, more complete combustion, higher fuel economy, and very clean emissions are its proven features. But can it be mass-produced? That remains to be seen. PROCO, developed originally for the Army Jeep, uses a rich mixture of fuel/air to ignite a much leaner mixture—a torch-ignition effect—to achieve its advantages. Disadvantages are the cost of its high-pressure fuel-injection system and the unproven design of many new components, including unique long-electrode spark plugs.

Ford's diesel idea

Just in case the PROCO project falls short, Ford is protecting itself in the diesel-engine field. Researchers are beginning to study the possibility of converting to automotive use a three-cylinder diesel engine that is used for farm tractors. The odd-cylinder diesel would be installed on the company's smallest models, and would get Ford's foot in the diesel door early, while more development time is spent on four-cylinder and V6 diesels.

Chrysler's new small cars

Chrysler will depend heavily on proven foreign-car practices in its new subcompact Plymouth Omni/Dodge Horizon. Front-wheel drive, a five-door hatchback body, metric nuts and bolts, and fastback styling are among the features lifted directly from overseas models. The engine will be transverse-mounted, a first for U.S.-built small cars. The suspension features coil springs all around. Horizon/Omni will be priced to compete with most small imports. A series of optional packages will also be available to upgrade the basic car. Very little interchangeability with other Chrysler products is found, though the front bucket seats are the same as those Chrysler uses in its 1978 compacts and intermediates. The engine is an OHC 104.7-cu.-in. cast-iron four that is a copy of the VW Rabbit engine.

Answering the van question

A Multi-Purpose Van (MPV) under development at GM will be smaller than present compact vans, yet have virtually all the same attractive features. Smaller also means better fuel economy—20 mpg-plus is a goal. GM plans to use the front-drive system being readied for the 1979 compacts in the new van. The MPV is about the same size as smaller vans used in Europe and Japan. It will spread the van craze to a lower price range, and open up more possibilities for personal-use markets. Front drive will mean elimination of the long drive shaft, a lower profile, easier loading, and more room inside for its size.

Styling small is tough

If you style cars, the smaller the project, the more difficult it is to make it unique and attractive. That's the word from William Mitchell, former VP and head of GM's design studio. An early look at the 1979 Chevrolet Nova confirms this conclusion. The four-door fastback is similar to the 1978 Buick Century and the new Plymouth Horizon. It has the same six-window greenhouse at the side, and a roof that slopes sharply down to the rear bumper. For the grille, it appears that Chevy picked off the Chevette design and made it bigger. PS

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P•Z•L Performs. I am considering using your new Pennzoil P•Z•L 10W-50 in my new Plymouth Arrow. Does this oil satisfy my new car warranty?

A.T., Hawthorne, CA

New Pennzoil P•Z•L is an extended life motor oil with synthetic. It is an SE oil and it definitely meets Chrysler new car warranty requirements and oil specifications. We're sure you'll be pleased with its performance in your new car.

"Pinging" Engine. I recently replaced the engine in my 1968 Chevelle Malibu with a 327 with 56,000 miles on it. Now when I accelerate, I hear something like marbles in the engine. I usually use regular gasoline. Could the gas be the cause of this noise?

M.C., Bellmore, New York

The engine noise you refer to is probably "pinging". With a properly tuned engine, pinging is usually a result of using a fuel with too low an octane number. The need for higher octane fuel increases with mileage. In your high performance 327 engine, the use of premium leaded fuel will probably eliminate the pinging.

Grease Bearing. I am a bit confused about what wheel bearing grease I should use for the disc brakes on my Dodge Challenger. I have been using a lithium base grease and haven't had any bearing problems, but I was wondering if there is in fact a special grease for disc brakes?

M.V.S., Madison, Wisconsin

Wheel bearings, adjacent to disc brakes, may be subjected to heat approaching 400°F. Multi-purpose grease can satisfy the demands of "normal service", but it may fail under "severe service" such as trailer towing, driving in mountainous terrain, or making an emergency stop from high speed—all of which generate high temperatures. In view of this, we recommend Pennzoil WBL 909, which contains an aluminum thickening compound, specially designed for disc brake systems.

Never, Never. I have a turbo-charged 285 h.p., air-cooled, fuel-injected engine in my aircraft. Aircraft oil appears to be available only in single weight, which seems to be very hard on the engine when starting in cold weather. Could I use Pennzoil Racing Oil 20W-40 in winter, instead of 40-weight aviation oil?

R.G.H., Algoma, Wisconsin

Nope! You should never use an automotive oil in your aircraft engine. Automotive-type oils contain metallic additives which cause combustion chamber deposits that could result in pre-ignition and damage to the pistons in an aircraft engine. Although single weight oils aren't as convenient as multi-grade, we strongly suggest you follow your engine manufacturers recommendations and use the appropriate Aircraft Oil for temperatures encountered.

Dipstick Deception. I drive a '67 Ford 240 engine with 71,000 miles. About 200 miles after I put in new oil and a new oil filter, the dipstick registers a quart over. I then remove one quart of oil, which alleviates the problem for 50 miles or so, until the oil level starts to rise again. The car is used only on short trips less than a mile or two at any one time. What do you think is causing this situation?

J.F.C., Toledo, Ohio

Since your trips are less than a couple of miles, your engine does not reach its optimum operating temperature. The result is that unburned fuel enters your crankcase and is not driven off because your engine remains cold. However, one quart of fuel every 200 miles sounds quite high, and we suggest that you be certain that your engine is properly tuned. Also, under these severe driving conditions, we recommend that the oil and filter be changed every three months or 3,000 miles.

Constant Pennzoil User. I've used Pennzoil for two decades, and have purchased 17 new and 5 used cars so far, and each is protected with Pennzoil, with oil changes at less than half the recommended intervals. We feel we've really done our part to preserve resources by keeping the motor in perfect shape. Our authorized VW mechanic said he'd never seen another VW as clean as ours after 52,000 miles. We have always carried a spare can of Pennzoil in the trunk of each car, too, so we wouldn't have to buy some other brand in a pinch.

L.D.H., Earlham, Ia.

We appreciate your kind words about Pennzoil. Many thanks. We're happy to hear about such good experiences.

WE'RE OPEN TO QUESTIONS about motor oils, lubricants, engines. But, you can tell *us* a few things, too. Maybe you have discovered something interesting about motor oils or lubricants. Or you have a special reason for being a Pennzoil fan. We would like to hear from you. Write to: Pennzoil Company, Research Department, P. O. Box 808, Oil City, Pennsylvania 16301. Note: sorry no pictures or material can be returned. Letters chosen for publication are subject to revision necessary for publication requirements.

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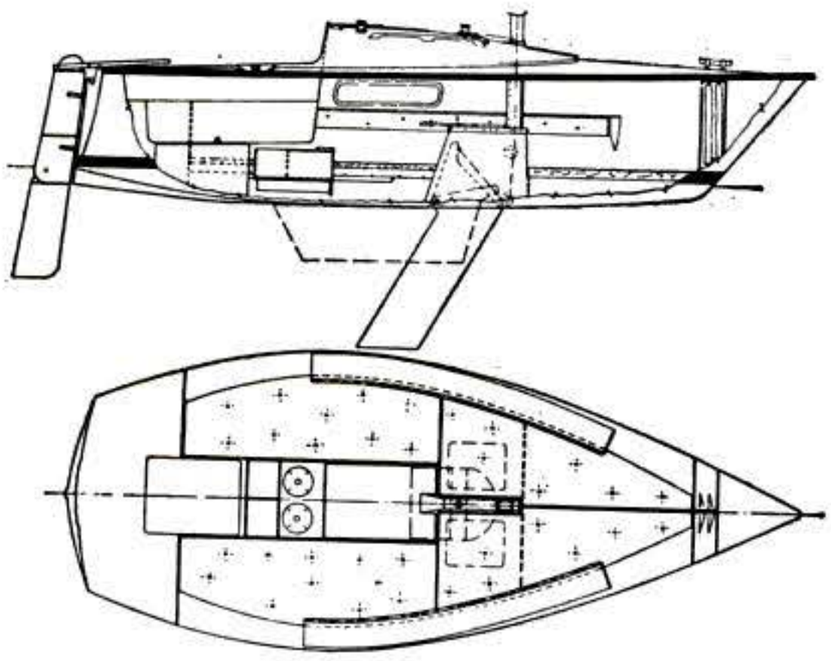
BOATING BEAT

By BOB BLACK

New cruising sailboat

The new Albin 57 is a mini-cruising sailboat with overall length of 19' and beam of 7'11"—which actually sleeps four people in comfort, although the waterline length is only 16'5". The boat is trailerable, with an adjustable keel and kick-up rudder that permit shoal-water cruising. And one can also sail offshore, thanks to 562 pounds of keel weight. The price is reasonable: $5995. Albin Marine, Inc. is at River Road in Cos Cob, Conn. 06807.



The Great Engine Race (continued)

Here we go again. Evinrude and Johnson are kicking the top-of-the-line engines up 35 horsepower each and both are introducing new 235-hp V6 motors this fall. Not far behind is Mercury Marine, bringing in its largest Black Max at 200 hp. Chrysler Marine has introduced new 115- and 85-hp engines, and more may be heard from the Detroit maker before the horsepower race is through.

According to Evinrude, its new 235 will meet a demand for outboard power on the "increasingly large outboard boats." Evinrude "finds it necessary to provide the higher horsepower capable of powering the largest of outboard offshore, sportfishing, and cruising boats at part throttle and at mileage-efficient speeds."

Johnson officials say that the 235 will replace twin outboard installations. "It doesn't take much to figure out that the customer will pay less to buy and operate one V6 than to buy and operate two four-cylinder outboards," says Johnson.

Overall, Mercury's new model line for 1978 has five new motors: the 200-hp V6; a 150-hp V6; the 140-hp Merc 1400; the Merc 900—a six-cylinder, in-line 90-hp motor designed for the bass-boat market; and the 80-hp Merc 800.

Fuel-tax rebate debate

Boating-industry representatives recently told a House Ways and Means Committee hearing that the industry "supports President Carter's plan to eliminate the two cents a gallon federal tax rebate."

However, the industry spokesmen suggested that the money be used to develop and improve boating facilities in and around urban areas, where most boat people live. The industry report said that "there is an acute shortage of facilities in such areas, with thousands of boat owners on waiting lists for berths or slips and thousands more cueing up at launching ramps. Alleviating the metropolitan boating-facilities shortage with federal motorboat-fuel-tax revenue would not only take the edge off the abolition of the fuel-tax rebate, it would cut highway use of fuel by boatmen traveling from urban areas in search of facilities."

Kevlar revisited

After two years of service, the Kevlar hulls on the Hydra-Sport bass boats seem to confirm the initial enthusiasm of owners. A recent survey made for Du Pont found that 98 percent of owners say Kevlar hulls lived up to their expectations. (The aramid fiber is used with traditional fiberglass for lighter, stronger hulls.)

And speaking of Kevlar, it made its appearance as a sailcloth again at the America's Cup. One of the sails designed by Lowell North, the highly regarded west-coast sailmaker and skipper, was a Kevlar main. It still has a way to go as a sailcloth, however, because there is a continuing threat of chafing from the shrouds. A Kevlar sail is very brittle, and a chafe can rapidly turn into a hole.

Trailerable trawler

Henry and John Henney, a couple of amateur boat builders in southern California, built a 24-foot trawler that cost them less than $9000, including a small diesel engine.

The trailerable trawler yacht was built from "Hercules" plans sold by Glen-L Marine Designs (9152 E. Rosecrans, Bellflower, Calif.). The plans cost the Henneys $42. The boat sleeps two adults and two children, plods along nicely at eight knots using less than a half gallon per hour, and has a cruising range of over 1200 miles.

The little yacht was recently appraised at over $18,000, although the cost to build was half of that, excluding scrounged materials (for example, the mahogany for the structure and the joinery came from Japanese-motorcycle crates, which abound in the area).

Women in boating

Women's Lib is one thing, but women in boating quite another, according to the editors of "Women in Boating," which is

published bimonthly from P.O. Box 787, West Chester, Pa. 19380. Most of the new tabloid's material is written by women.

Regarding the U.S. Power Squadrons' foot-dragging expedition on permitting women membership, the policy is clear: "Women in Boating is *NOT* against the USPS. WIB is well aware and agrees that the power squadrons provide one of the best sources of educational boating safety and information service in the U.S. . . . The courses given by the USPS help save countless lives and prevent loss of equipment and boats each year. . . .

"We applaud and agree with everything the USPS does and stands for, except their treatment of women as second-class citizens. . . .

"WIB is not a women's-lib organization, but rather a group of women interested in all aspects of boating. All we ask is to be treated equally in the boating community. . ."

I wonder when the USPS is going to smarten up and drop its legal foot-dragging? It makes this power-squadron member squirm. When I was an instructor, some of my best students were ladies, and they surely deserve membership! PS

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And yes, lower 'tar' than Winston or Marlboro.

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2. VICEROY HAS A UNIQUE, AGED-BLEND OF NATURALLY LOW 'TAR' TOBACCOS AND A SPECIAL PROCESS THAT ALLOWS THE USE OF MORE PARTS OF THE TOBACCO LEAF THAT ARE LOW IN 'TAR'. (VICEROY 16 MGS. 'TAR'; WINSTON 19 MGS. 'TAR'; MARLBORO 18 MGS. 'TAR'; AVERAGE PER CIGARETTE, FTC REPORT, DECEMBER, 1976.)

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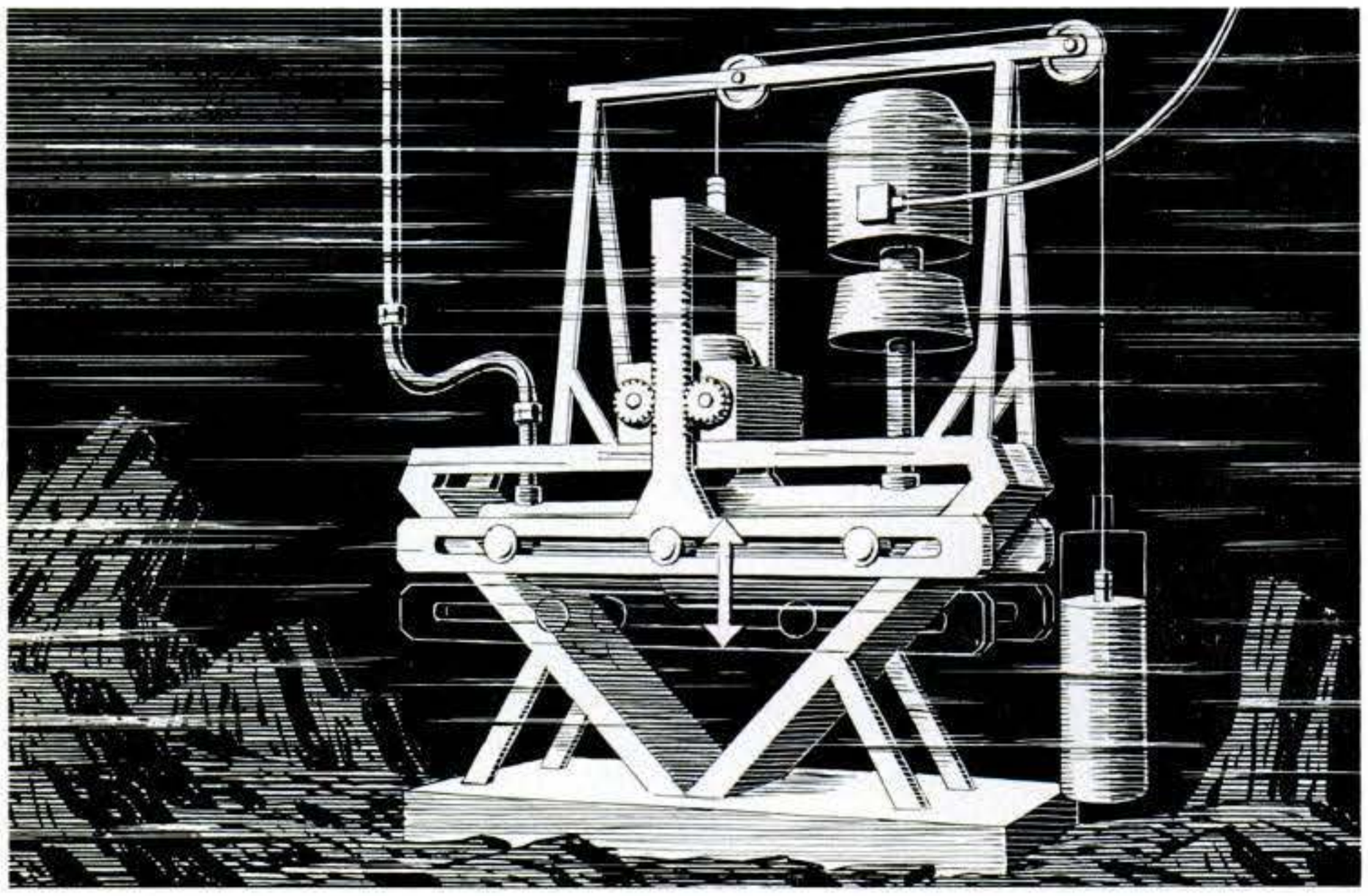
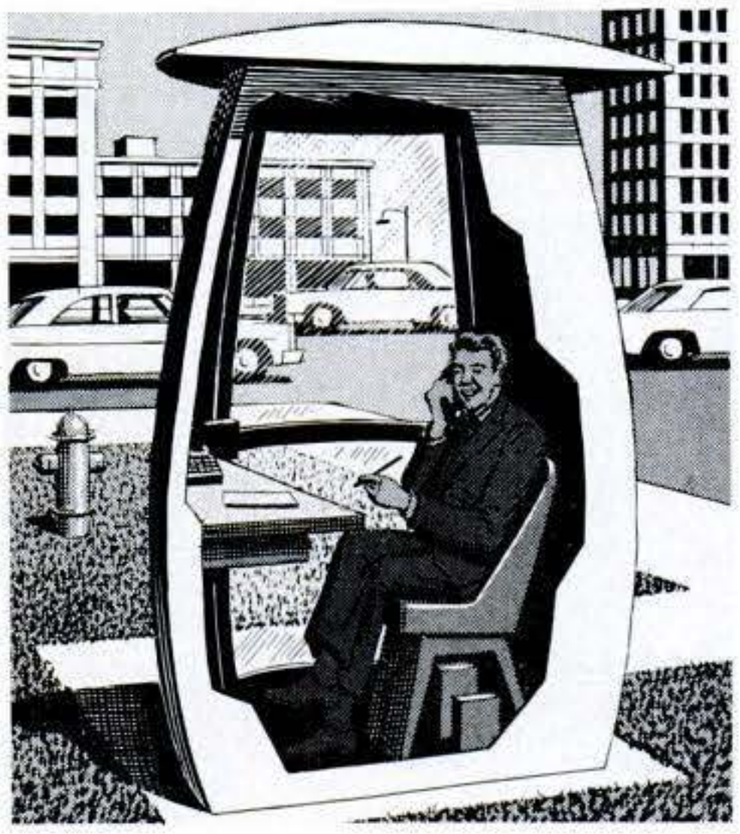
NEW IDEAS FROM THE INVENTORS

ILLUSTRATIONS BY RAY PIOCH



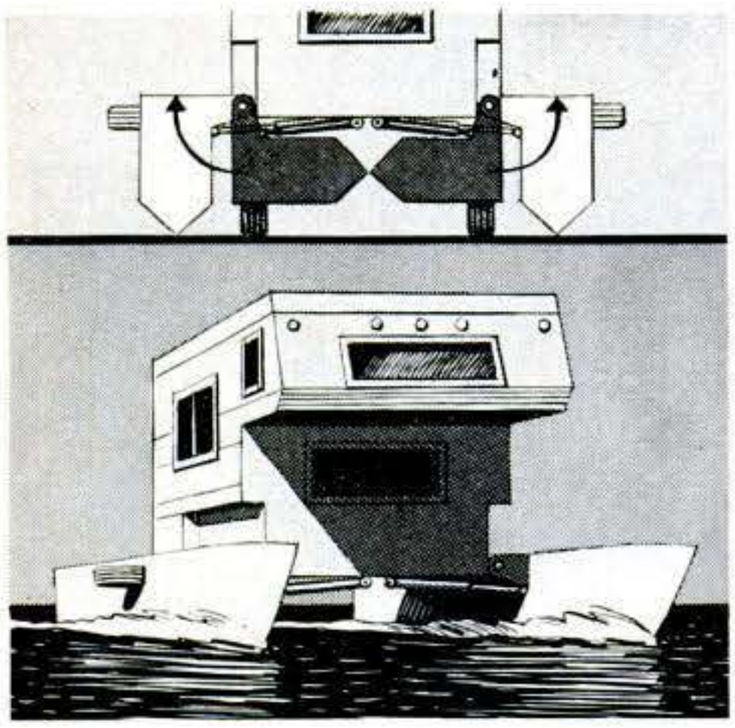
Telescoping pump generates power in deep water

Anchored to the bottom of the sea, this power generator would enclose a valved chamber so that it was alternately opened and closed to sea water. Surrounding water, at extremely high pressure, would be valved in to lift the piston of a telescoping reciprocal pump. Counterweights would partially power the motorized downstroke for minimum energy loss, and the output of the pump would be tapped to operate a submerged or surface-level electric generator.



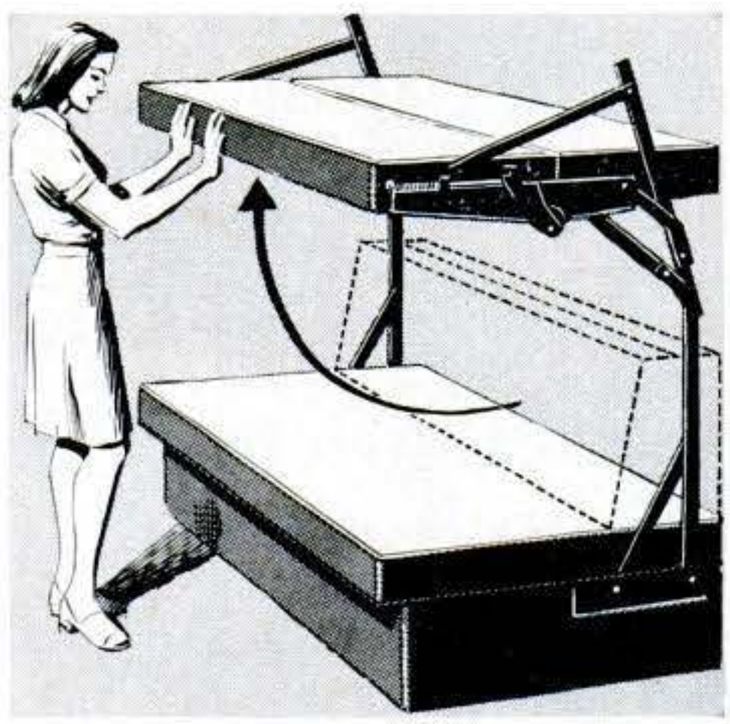
Credit card opens field office

A network of roadside offices like these, with doors that could be opened by magnetically coded credit cards, might allow salesmen and other business travelers to work more comfortably and efficiently. If the air-conditioned, office-equipped cubicles were set up by a credit-card company, the magnetic code could be used for automatic billing of use-time, phone calls, and other services provided.



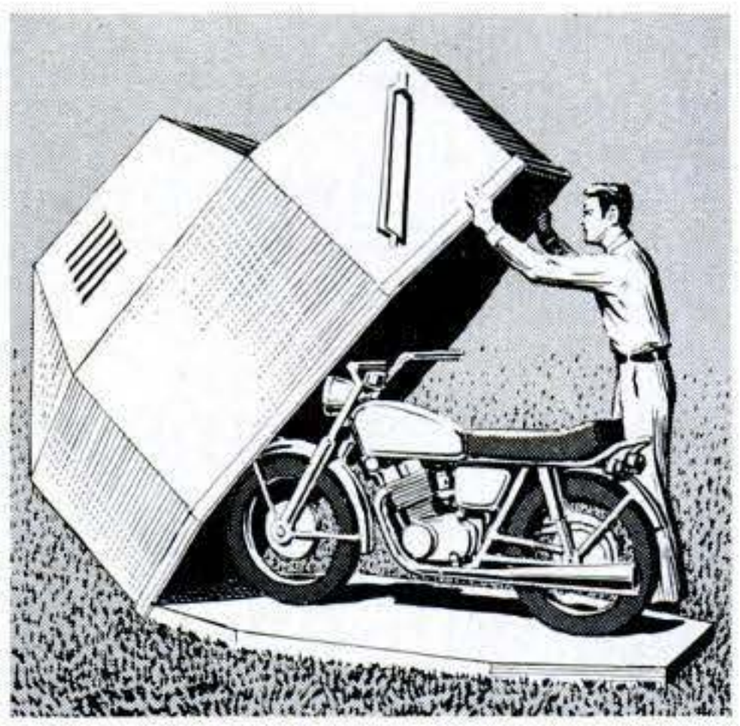
Pontoons float camper-boat

Attached to the sides of a truck camper and rotated on toggle links, these longitudinal floats would swing down below the wheels to float a camper, add stabilizing width and deck space, and cushion the lightweight superstructure against the pressure of rough water. In one version the camper would be removed to convert the houseboat to a catamaran.



Sofa back forms upper bunk

Most convertible settee or sofa beds need clear space in front in order to open up. This convertible would provide extra sleeping accommodations in rec vehicles and other floor-limited places by hinging the backrest so it could be swung up to form a raised bunk. In the daytime, the longitudinally doubled bunk would fold into a seat-depth backrest.



Drive-in shell garages cycle

Hinged to a floor plate that is solidly staked to the ground, this rigid molded shell would tip down over a parked cycle to protect it from the elements and—when locked—from casual thieves or vandals. When open, the housing would rest securely on its flat molded back so you could drive the cycle onto the floor plate before dismounting.

The following patents have been issued on these inventions: **Deep-sea generator**—No. 3,994,134 to S. Molnar, Flushing, N.Y.; **Camper-boat**—No. 3,860,982 to R. Rumsey, Buffalo, N.Y.; **Sofa-bunk**—No. 3,863,280 to N. Mizelle, High Point, N.C.; **Field office**—No. 3,959,607 to J. Vargo, Verplanck, N.Y.; **Molded-shell cycle garage**—No. 3,861,092 to W. Dale, Versailles, Ky., and W. Britsch and C. O'Dell, Lexington, Ky.

Copies of patents may be ordered, by number, from the Commissioner of Patents and Trademarks, Washington, D.C. 20231, at 50 cents each. To write to an inventor, if address above is insufficient, address him by name and patent number in care of the Commissioner.

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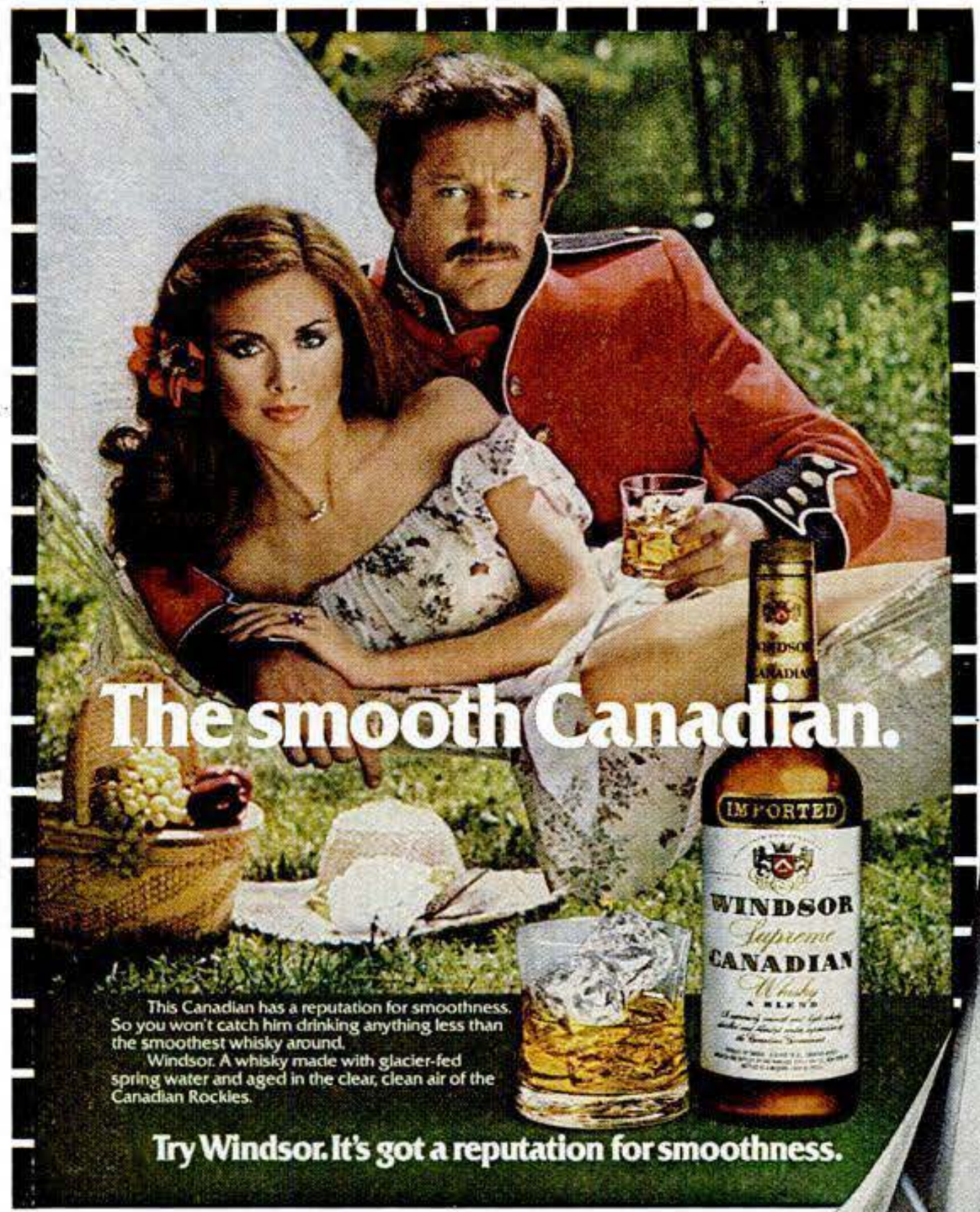
When is an ad worth $20,000?

(When it's a Windsor Canadian ad and you enter it in Windsor's Smooth Canadian Sweepstakes.)



This Windsor advertisement may make you $20,000 richer. There's nothing to buy, and it's easy to enter. Here's all you do:

One: Cut out this ad or any Windsor Canadian ad from any magazine or newspaper. **Or** cut out any liquor store's newspaper ad that features a Windsor Canadian bottle.

And while you're cutting out the ad, why not sip some Windsor Canadian. And savor the taste of the smoothest whisky ever to come out of Canada.

Two: Print your name and address clearly on the ad or on a 3" x 5" piece of paper. Attach it to the ad and send it in an envelope to: Windsor's Smooth Canadian Sweepstakes
P.O. Box 91
New York, N.Y. 10046

Sweepstakes rules: Enter as often as you like. No purchase is necessary. However, each entry must be mailed separately and

Name_____
Address_____
City & State_____ Zip_____

postmarked by December 31, 1977, to be eligible for the drawing. Photocopies of Windsor ads are not acceptable. The winner will be notified by mail after February 15, 1978.

• **Entrants must be of legal drinking age under the laws of their home states.**

• This sweepstakes is void in those states where prohibited by law.

• The winner will be selected by random drawing under the supervision of Marden-Kane, Inc., an independent judging organization, whose decisions are final.

• All applicable taxes are the sole responsibility of the prize winner.

• The Windsor Canadian Sweepstakes is open to residents of the United States. Employees and their families of National Distillers and Chemical Corporation, its advertising agencies, its wholesalers, retailers, all liquor licensees, distributors and their salesmen, and Marden-Kane, Inc., are not eligible.

• All federal, state and local laws and regulations apply.

Odds of winning will be determined by the number of entries received. The more times you enter, the greater your chances to win.

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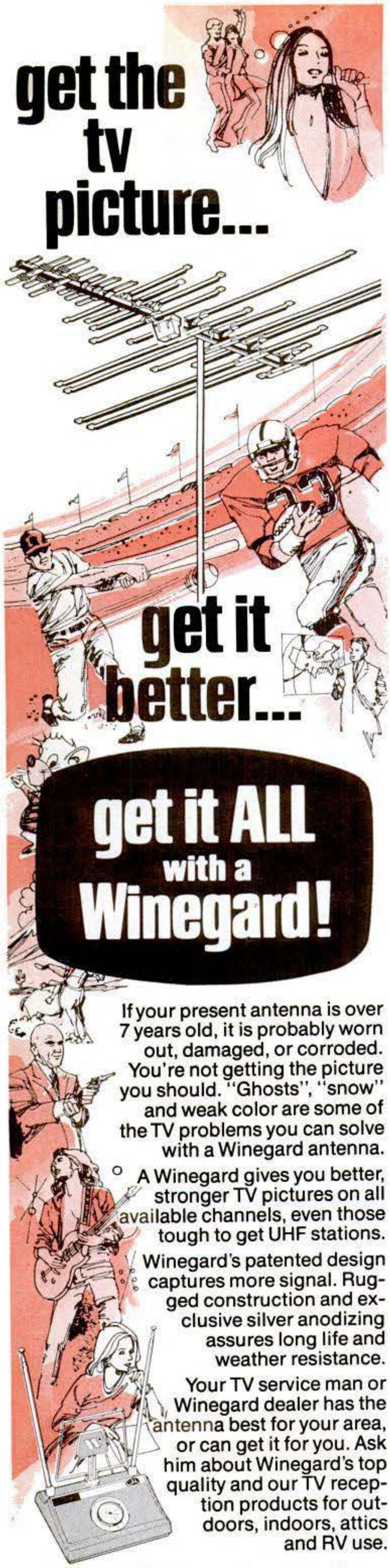
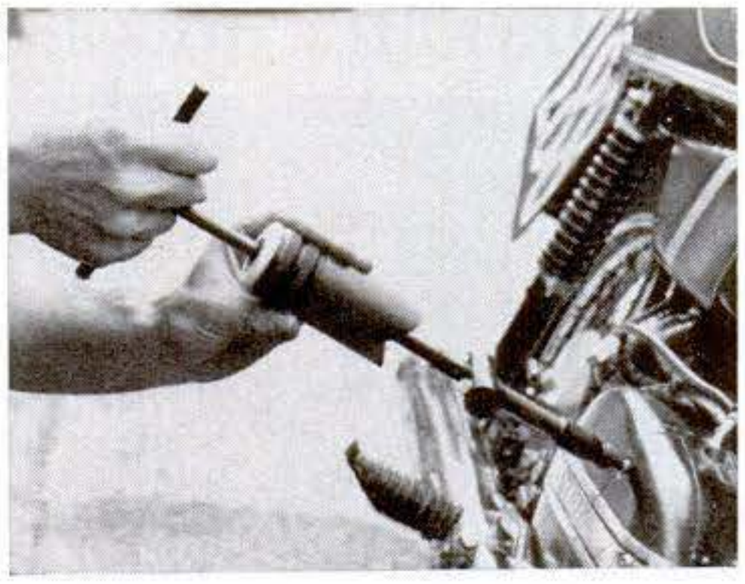


MOTORCYCLING

By RAY HILL



T-handle impact tool

Here's a neat tool for loosening and tightening Phillips screws on your motorcycle. Unlike conventional impact drivers that you strike with a hammer, the T-handle has its driver built in. With a little practice, you can vary loosening or tightening pressure from feather-light to very strong.

It comes with four interchangeable tips, two for undamaged Phillips heads, and two extractor tips for damaged heads. With the extractor tips, I've removed screws with the head slots totally ruined. The impact tool is $24.95 from motorcycle shops that handle Full-Bore products, or from Joe Belger Products, Inc., Barre, Mass. 01005.

Tape-on wheel weights

Properly balanced wheels are necessary for a smooth and safe ride on the street or on the race track. There are different ways of balancing wheels, but the easiest I've found is with Tape-A-Weight from Gottwald Industries in Akron, Ohio. You just peel off a paper backing and stick the weight on.

I've seen some people put duct tape over the weights as a backstop against flying off. But I've been using the weights without tape on both my street and racing machines, in wet and dry conditions —and they've never come off. They've even stayed on during a couple of heavy crashes at the track. Yet if you want to remove a weight, you can pull it off with your fingers. Some adhesive remains on the rim, but it can be scraped off easily with a razor blade.

Tape-A-Weights are available at bike shops in six-ounce packages ($2.50 for standard weights, $3.20 for chrome-plated ones). They can easily be cut to size with pliers.

New threads for old

What do you do when you accidentally wipe out the threads beyond repair in a vital part of your motorcycle engine—say, an engine case, cylinder, or head? Ride over to your local motorcycle shop and have him order a Heli-Coil for you. I say *order*, because finding a motorcycle dealer who stocks Heli-Coils is about as easy as casting your own engine cases. The Heli-Coil division of the Mite Corp. in Danbury, Conn., makes them, but does not sell directly to the public.

Here's how the Heli-Coil system works. You tap out the damaged hole with a tap that comes in the kit, then screw in a Heli-Coil with its special tool. The Heli-Coil is a particular alloy wire shaped in a coil form. Once it's screwed in the hole, you can screw in the original-size bolt or stud. In effect, the Heli-Coil becomes a fresh set of threads. When the job is done properly, the Heli-Coil is as strong as the original threads.

Kits are available for the three most common sizes: 6 mm, 8 mm, and 10 mm. Prices range from $14 to $17 per kit. Each kit contains everything you need to repair a damaged hole, including a supply of Heli-Coils. Extra coils are available in bags of 12 ($2.65 to $4.25).

Continued

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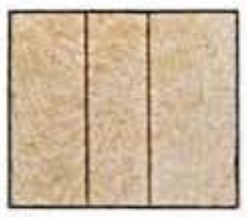

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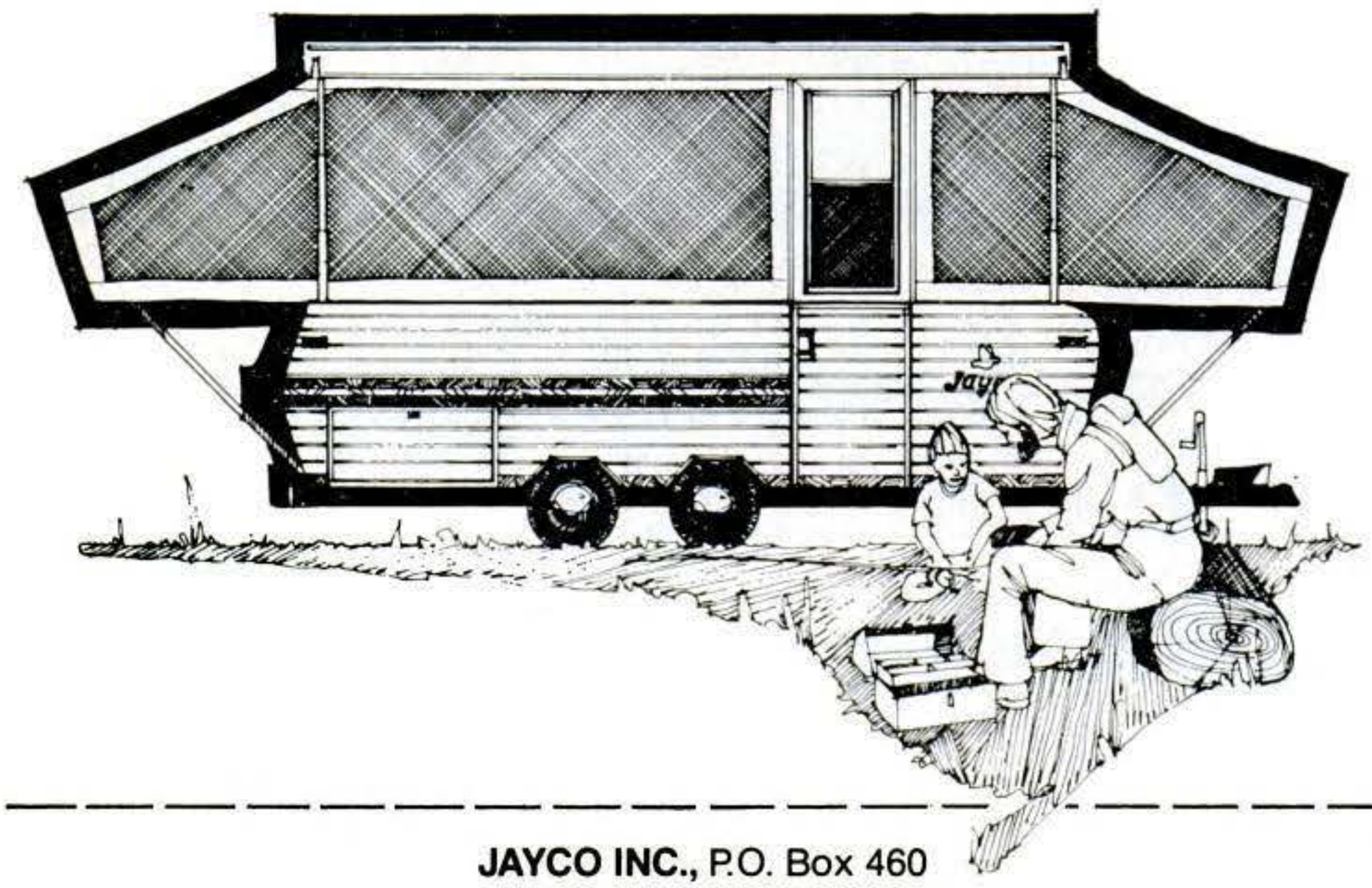

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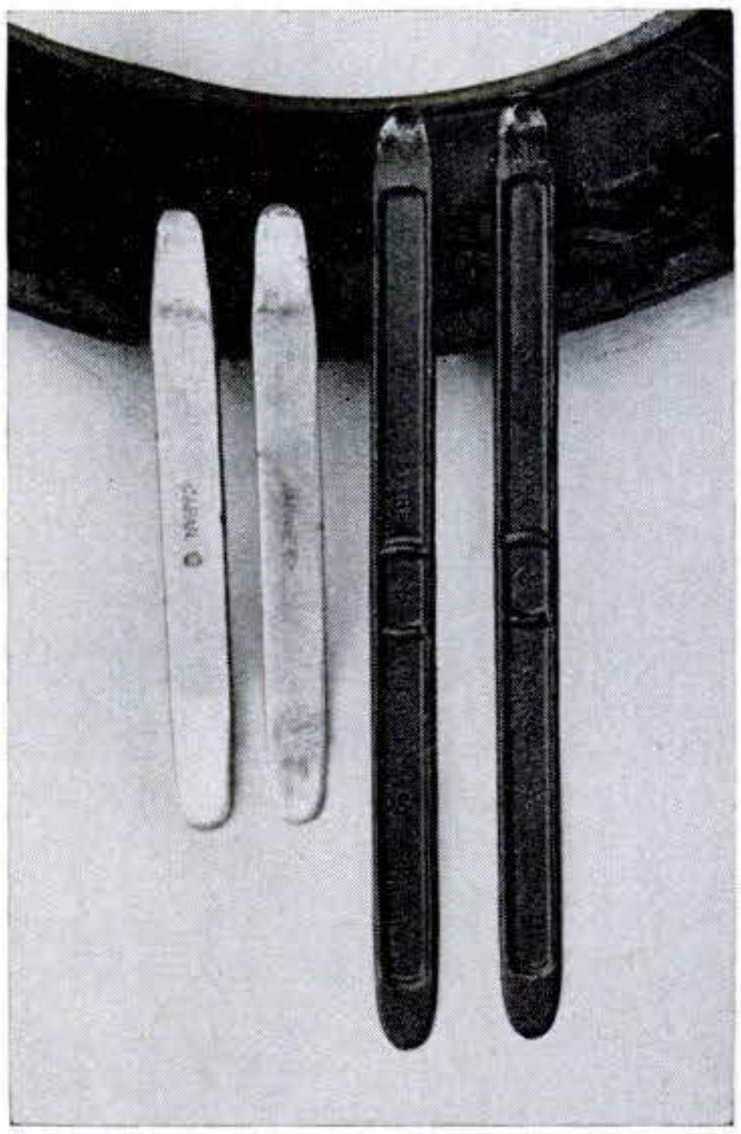
[*Continued*]

Also available is kit number 4690. It contains everything you need to make repairs on holes of all three sizes.

Tire irons and tire changing

If you think of changing tires as one of those miserable jobs involving hours of sweat, skinned knuckles, and four-letter words—well friend, you haven't changed enough tires. Or you haven't been doing it right. It's not all that bad.

One of the most important things to remember when replacing or removing a tire from the rim is to keep pressed down in the rim's drop-center as much of the tire bead as possible. That leaves room to slip the part of the tire bead you're working with over the rim's lip. If you try to work with the tire without keeping as much of the tire bead in the drop-center as you can, then you really are fighting a losing battle—that leads to bead-tearing and heavy swearing.



Still, prying the tire on and off takes a fair amount of leverage. And while you can do it with the standard-size tire irons pictured (above left), which so many bike shops sell, you can do it much more easily with longer tire irons. Whether you're an old hand at tire changing or a novice, you'll like long irons better. If the folks at your local shop don't have any, ask them to order a set for you.

For the racing enthusiast

Who was the only man to be grand-national champ four years in a row? Answer to this and lots of other questions are in the AMA's 1977 Motorcycle Racing Annual. $6.45 from Oxman Publishing, 3629 W. Warner Ave., Santa Ana, Calif. 92704. PS

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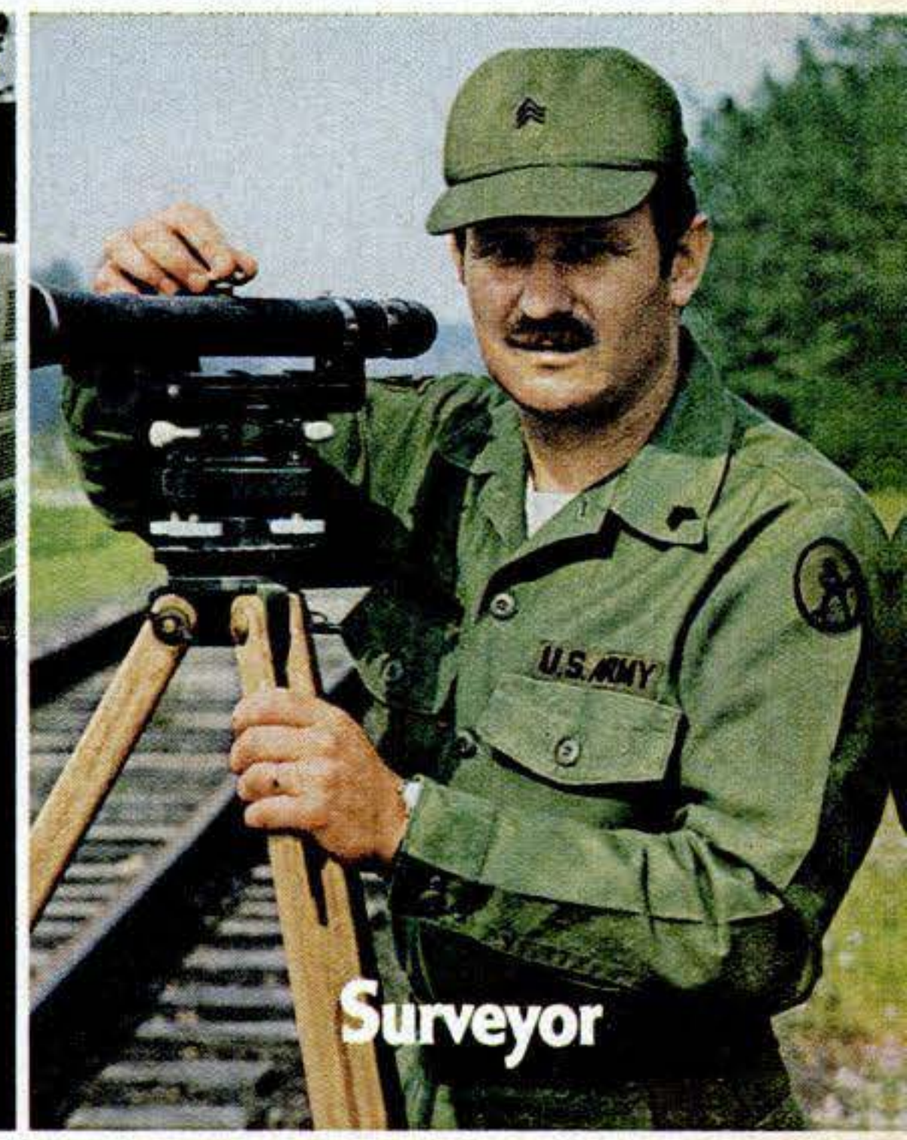

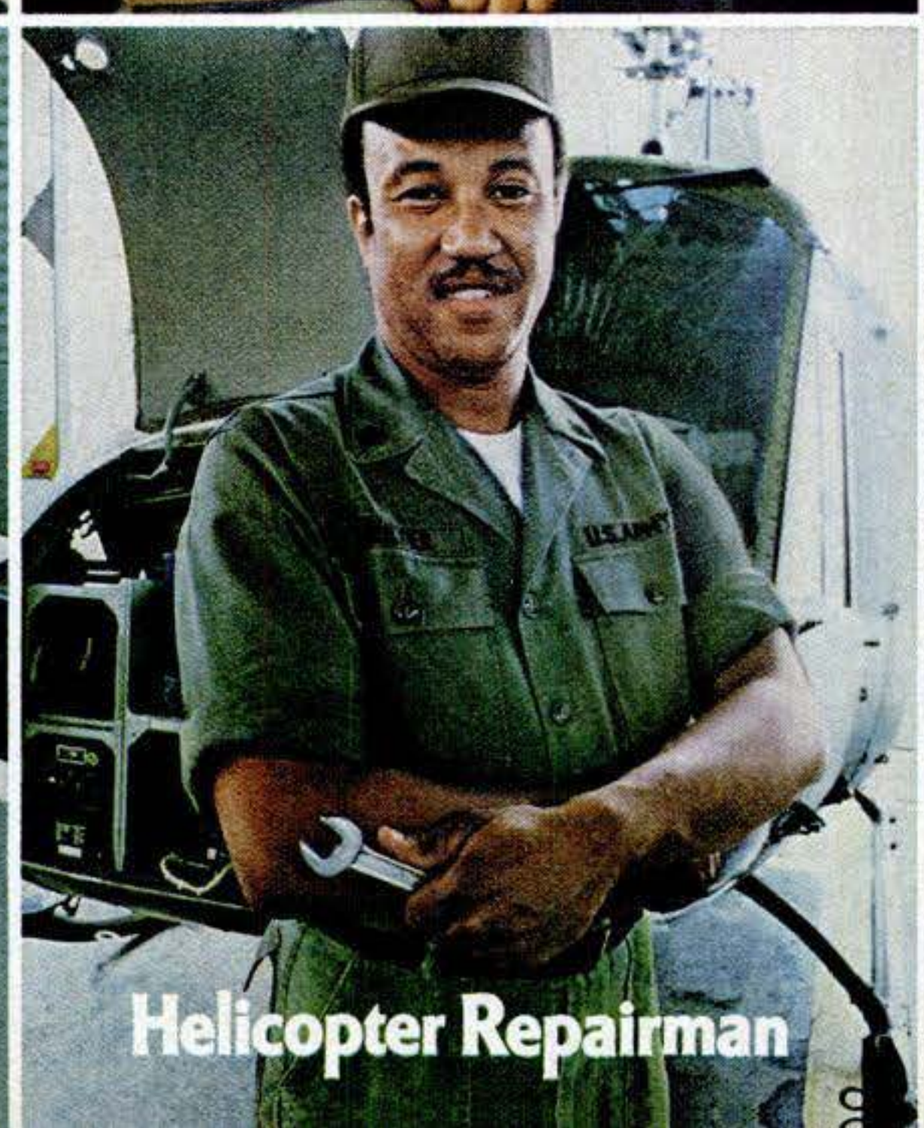

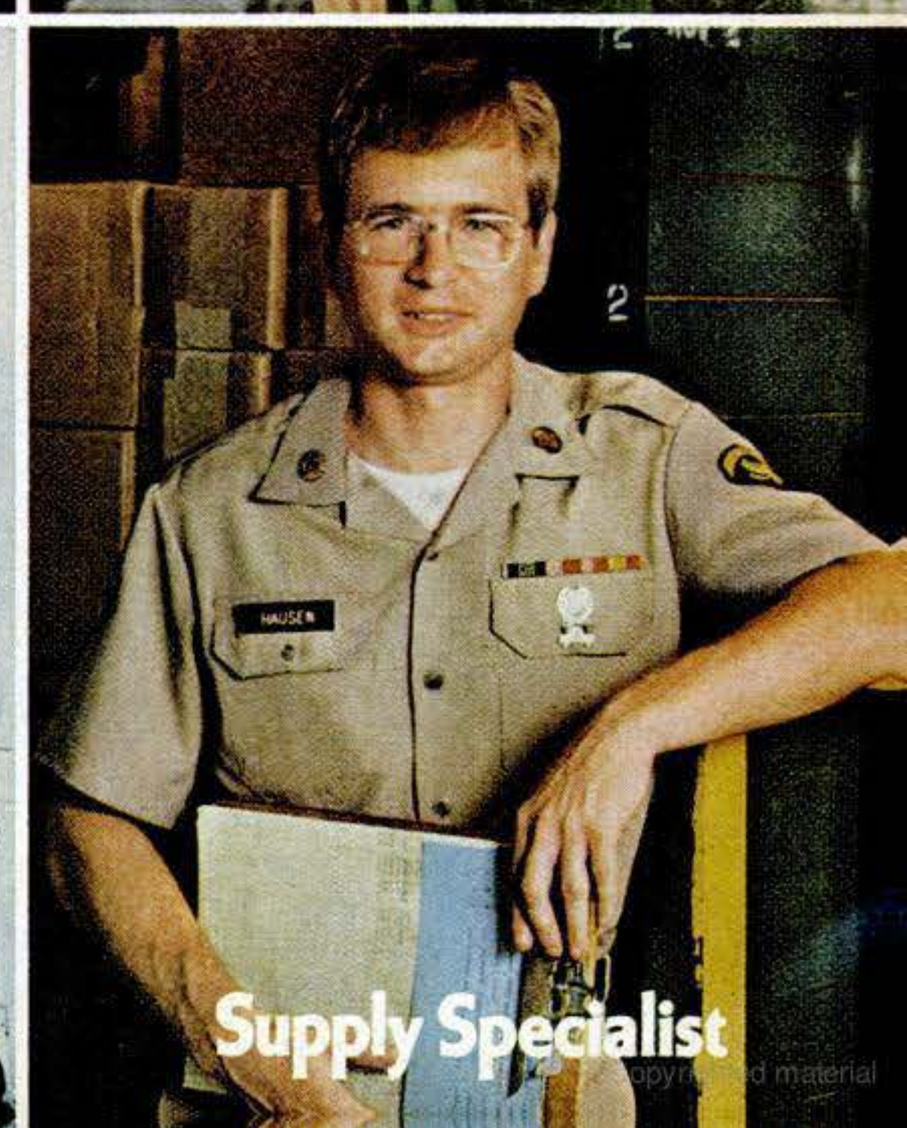

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Get rid of fall litter with lawn vacs and blowers

It's not a rocket belt—it's Stihl's backpack blower blasting away leaves and other debris with a strong jet of air.

Powerful wind machines make fall cleanups faster and easier

By MARK LINDSLEY

Has autumn lost its splendor because your favorite football team is battling for first place—while you're stuck in the backyard raking leaves? Maybe it's time to use a wind machine on your lawn.

Wind machines—lawn vacuums and blowers—can perform a wide variety of fall cleanup tasks. These back-saving machines fall into three general categories: leaf blowers, lawn vacuums, and backpack blowers.

A leaf blower, the simplest wind machine you can buy, has a turbine-type fan powered by a three- to five-hp engine. This powerful jet-on-wheels blasts air from a ground-level chute. After some practice with one, you should be able to produce neat stacks of leaves ready for bagging or burning.

Continued

Grabs 'em, chops 'em, bags 'em—Toro's yard vac (above) sweeps up fall leaves in a hurry. Replace the sweeper head with the suction hose (right) and you can get into the tough spots under shrubbery and by foundation walls.

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Since we can't say how many hours XX hours is, we'll just have to content ourselves with telling you this: Old Spice Stick Deodorant gives you fresh, clean Old Spice fragrance and protection up to 24 hours.

Give or take an XX or two.

SHULTON

[*Continued*]

Adjustable jet on this Yard-Man sweeper lets you blow straight ahead or off to the side. An optional vacuum shredder cuts down yard-cleanup time.

The push-propelled blowers offered by most manufacturers are adequate for this job. But when you choose your machine, check wheel size. Small wheels can get hung up by every gopher hole and hummock in your yard. Ten- or 12-inch wheels will roll more smoothly, and cut down the wrestling needed for the job.

Leaf blowers are generally the cheapest wind machines you can buy (see table). Accessories add to the price, although most manufacturers offer only limited options. Notable exceptions are Toro and Yard-Man, which offer extension hoses and vacuum-bagger attachment kits. Blower hoses can reach under bushes and into corners where the machine itself won't go, and the directable stream of high-pressure air will even pry up soggy clumps of wet debris from underneath bushes.

The lawn vacuum is a more sophisticated way to tackle year-round yard care. It can suck up summer grass clippings as well as fall leaves. As a bonus, it does a fine job of cleaning the garage floor, or even a party-littered patio.

The lawn vac, like your home machine, usually has a vacuum inlet and a blower outlet. The similarity ends here. These lawn-care marvels are not scaled-up versions of your friendly Hoover, but scaled-down replicas of the giant truck- and tractor-mounted machines used for industrial and municipal cleanups. Lawn vacs are powered by hefty five- or six-hp engines that drive internal fans. Unlike leaf blowers, the vacs can gather—and chop—refuse, reducing its volume. Discharge air then forces the choppings into a collection bag. These baggers pack about four bushels of refuse into a one-bushel space. Some baggers use disposable trash bags, so all you have to do is tie the neck shut and haul away the lot.

Most of today's lawn vacs convert, on the spot, from power vacuum to power blower. You simply remove the vacuum head and rotate the fan body to the blower position. Combine this versatility with a large-diameter (10- or 11-ft.) hose and you have a machine that can clean under eaves and get into crooks and crannies in the garage.

The uses of a convertible vacuum/blower unit are limited only by your imagination and the accessories you buy. But it's best to rent and try before you buy. Pushing four bushels of wet leaves around the back forty is the kind of exercise most of us can do without. Small wheels and suction heads that catch on anything in sight compound the problem. Some better lawn vacs are self-propelled; others have trailer hitches so you can tow them behind your lawn tractor or rider mower. Most models have a height adjustment on the intake nozzle so you can tailor the machine to your lawn. The nozzles are wide enough to pick up large objects such as paper cups and beer cans. But the vacs aren't all-out mulcher/shredders, so you should get rid of cans and rocks before vacuuming your lawn. The

Continued

Buyer's guide

Manufacturer/model	Type	Self-propelled	Weight (lbs.)	Nozzle width (in.)	Hp	Sugg. retail price	Comments
Billy Goat Industries, 1830 S. Jefferson St., Lees Summit, Mo. 64063							
KD-50SP	Vacuum bagger	Yes	130	n.a.	5	$410.00	Deadman clutch, freewheeling neutral, folds for storage
Winro BL-52	Blower	No	63	n.a.	5	240.00	Home and industrial sweeper
Echo (Kioritz), 350 Wainwright, Northbrook, Ill. 60062							
PB-9	Backpack blower	n.a.	19.62	n.a.	3.2	n.a.	Attachments available for liquid or powder spray, rotary scythe, flamethrower
PB-501	Backpack blower	n.a.	n.a.	n.a.	n.a.	n.a.	New, no further info. available
Lambert Corp., 520 Hunter Ave., Dayton, Ohio 45404							
Chew Chew, Model							
VMB-3530	Vacuum bagger	No	82	30	3.5	290.75	Blower, vac.-hose, shredder-hopper attachments available; trailer hitch standard
VMB-5030	Vacuum bagger	No	89	30	5	366.95	Same attachments as above; trailer hitch standard
VMB-5530S	Vacuum bagger	Yes	117	30	5	529.95	Attachments as above; no hitch
Montgomery Ward, 616 Chicago Ave., Chicago, Ill. 60607							
89 FR 37900 R	Vacuum bagger	No	150	30	6	289.95	Vacuum-hose, leaf-blowing kits available
89 FR 37901 R	Vacuum bagger	Yes	162	30	6	359.95	Same attachments available as above
X 89 FR 29379 K	Backpack blower	n.a.	29	n.a.	3	299.95	Built-in liquid sprayer
Sears, Roebuck & Co., 925 Homan Ave., Chicago, Ill. 60624							
Leaf Blower 9 KF 7984N	Blower	No	68	n.a.	3.5	155.00	
Lawn Valet 9 KF 7986N	Vacuum bagger/ blower	No	107	25	3.5	233.00	Convertible unit, hose-rod kit available for vacuuming and blowing
Stihl Inc., 5701 Thurston Ave., Virginia Beach, Va. 23455							
BG-17	Backpack blower	n.a.	17.6	n.a.	n.a.	239.95	Extra-soft shoulder pads available
SG-17	Backpack power	n.a.	17.6	n.a.	n.a.	259.95	Built-in liquid sprayer; soft shoulder pads, granulate-spreader, dusting kit, flame-thrower available
Toro Co., 8111 Lyndale Ave. S., Bloomington, Minn. 55420							
5-hp vacuum/blower							
Hand-propelled #62912	Vacuum bagger/ blower	No	115	30	5	349.95	Convertible unit; vacuum hose available
Self-propelled #62923	Vacuum bagger/ blower	Yes	130	30	5	399.95	Convertible unit: vacuum hose available
Leaf blower #62933	Blower	No	108	n.a.	5	249.95	Accessory hose/vacuum-bagger kits available
Yard-Man (MTD Products Co.), 5389 W. 130th St., Cleveland, Ohio 44111							
Vac Sweep							
Push #24670	Vacuum bagger	No	150	30	6	309.95	Vacuum hose and blower conversion kits available
Self-propelled #24680	Vacuum bagger	Yes	154	30	6	399.95	Same kits as above available
Jet Sweep #24690	Blower	No	90	n.a.	5	219.95	Blower chute adjustable for two directions; extension-hose and vacuum-bagger kits available

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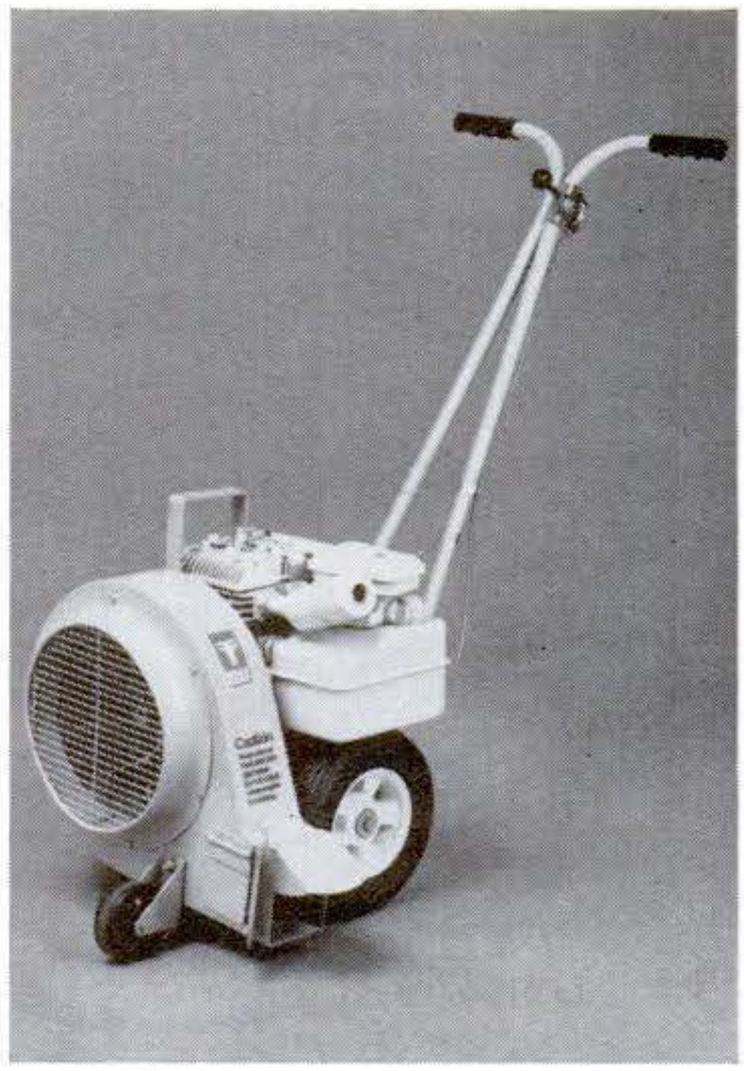
THE NEW BELL & HOWELL SLIDE CUBE SYSTEM II

[*Continued*]

exception to this rule is the Lambert Chew Chew, which has an optional shredder-hopper.

Backpack blowers are probably the most versatile of all lawn cleaner-uppers and may also be the most fun to use. Strap on one of these lightweight (under-20-lb.) units and you're ready to clean roofs, gutters, and a lot of other places that the heavier, wheeled blower units won't reach. You've got to try one to appreciate the 200-mph jet that rips and tears at hard-to-move debris. Backpack blowers will also remove the dry, fluffy snow from your car, porch, or sidewalk, blow standing water out of small boats, and accelerate the burning of stumps, leaves, and brush piles.

With a liquid sprayer tank (built in on some units and optional on others) you can spray insecticides up to 30 feet away—or to the top of the largest trees in your orchard. Additional accessories are available for dry-chemical or granulate spray. While backpack blowers can't match the extreme pressures of power sprayers, they can drive liquids hard enough to wash down campers, mobile homes, and outdoor power equipment. You can even spray water-base paints on fences or outbuildings, but for this application, as for so many others, you'd better observe the basic rule of all blowers: Stand upwind of your work.



Tough little Billy Goat leaf blower is light and compact, so it's easy to push around. You can work it in tight to get at leaves under shrubs and trees.

Fluffing or flaming

Other uses for the backpack blowers include spraying release compounds on concrete forms, applying sealant after the concrete is set, and fluffing show cattle before the big exhibition.

A couple of backpack blowers even have optional flamethrowers. These make short work of starting fires in the wettest brush piles or under the moldiest stumps. And one manufacturer, Echo, offers a rotary scythe attachment for clearing weeds and light brush from fence rows and hedges.

No matter which type of wind machine you decide to buy, it should save you time and effort. You may even get a chance to spend your Sunday afternoons enjoying the autumn (and the football game). PS

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New Chevy, Dodge, GMC fuel-stretching **diesel pickups**

By JIM DUNNE

If you've been awaiting the arrival of a pickup truck with a diesel engine under the hood, your wait is over. Dodge, Chevrolet, and GMC have diesel-powered pickups available in their 1978 lineups.

Dodge offers a 243-cu.-in. six-cylinder diesel as an option in the W150 and W200 light-duty pickups. A little bigger than the 225-cu.-in. slant-six gasoline engine (the standard power plant), the diesel offers slightly more horsepower—103 vs. 100. However, in a test drive of a prototype, I found it noisier, and acceleration was slower than its gasoline counterpart.

Chrysler imports the engine from Mitsubishi, in Japan, the same company that builds Dodge Colt and Plymouth Arrow sedans. In 1978 Dodge plans to sell fewer than 4000 diesels. This diesel is not the same one that Chrysler imports from Nissan and sells to International for the Scout II.

Dodge marketing experts see the diesel as playing a potentially big role in meeting the 1985 emission levels, provided the NO_x emission

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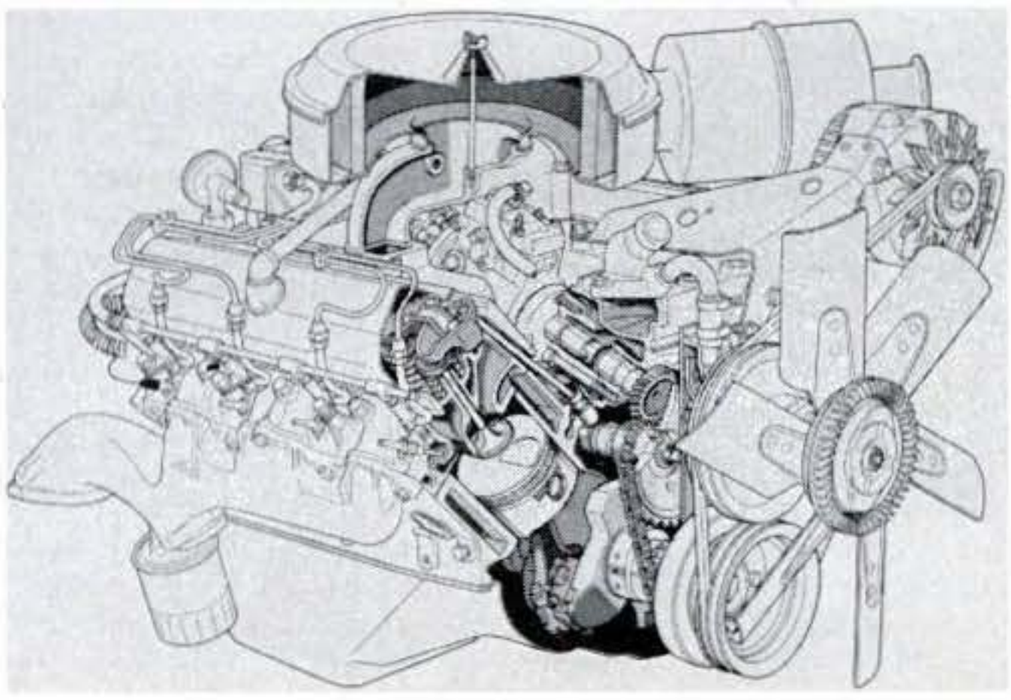

On the outside things still look the same, as shown by diesel-powered Dodge pickup above. Under the hood things are very different, though. Primary and secondary ignition wiring no longer exist. Fuel injectors are positioned where spark plugs normally are in a gasoline engine—as illustrated by cutaway of GM's diesel V8 at right. Fuel is #2 diesel.

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Imagine the computer as a printing calculator with ten separate memories. You enter the data on the unit's keyboard, but instead of a paper tape, you use your TV screen to scroll out the answers similar to the credits on a movie screen. You can balance your checkbook and then double check your calculations by scrolling back to your first entry. By comparison, an electronic calculator with ten memories alone would cost what this entire computer costs—but there's much more.

A CHALLENGING TEACHING TOOL

Your child inserts a cartridge in the Bally console. Three random math table problems are then flashed on your TV screen. Depending on the speed and accuracy with which those problems are answered, the Bally automatically programs the computer with your child's math level. Problems in addition, subtraction, multiplication and division are then flashed on the screen for the next three minutes, and the computer continually adjusts to a level slightly better than the math level indicated by the previous three answers. The math tables, therefore, remain a challenge no matter how good your child becomes. Psychologists, who were consulted by Bally, helped design the cassette. They stated that the cassette should stimulate math learning and improve grades.

On the same math cartridge is a two player game called Math Bingo. It adjusts to each player's ability so a parent can play against a child or two children can compete against each other at their own math levels—both with an equal opportunity to win. You first answer a math table problem similar to the first exercise; and with a pistol-grip pointer you move a square on your TV screen to the correct answer position on your TV bingo card. The game involves both math skill and dexterity. Each game is totally different since the bingo cards have a million different possibilities. Scoring is constantly displayed, and a typical game lasts approximately three minutes. You can play as many consecutive games as you wish. However, to start the score over, you press the reset button.

FUN AND ACTION ARCADE GAMES

Picture nine baseball players running out on your TV screen to the sounds of "Take Me Out to the Ball Game" as you step up to bat. That's the scene with Baseball, the arcade cartridge that plays two teams against each other with play so real that you hear all the music, sound effects and see all the action. There are walks, balls, and such realism that the pitcher covers first base when a ball is hit to right field—just like the real game. There are double plays, walks and errors—all part of nine innings of Baseball. On the same cartridge are several paddle ball games but with a new twist. Players can move the paddle, not only up or down like most TV games, but sideways and diagonally.

The Bally circuit board contains 34 integrated circuits including a Z80 microprocessor. This package represents more computing power in the hands of the consumer than was thought possible this early in the history of micro electronics. The mass production of these components and circuit board has made possible a quantum leap in lowering the cost of what normally would be a very expensive system.

Other popular arcade games include, Sea Wolf, Red Barron, Panzer Attack (similar to Tank) and dozens of games only previously available at arcades. These same games cost arcade owners up to $2,000 each.

MORE VALUE PER FEATURE

Let's quickly review the features—an electronic printing calculator with ten memories, a teaching machine that adjusts to your child's math level and an arcade center that replaces about $10,000 worth of electronic arcade games with just a few cartridges. Use any one of these features and you could justify buying this unit—but there's plenty more.

With all its sophistication, the Bally Library Computer was designed to keep current with advancing computer technology no matter how sophisticated the development. Bally has provisions in its present system for expansion modules. These devices will permit you to: 1) draw directly on your TV screen with an electronic wand in 32 different colors and eight shades of each color, 2) compose, record and playback music on an electronic synthesizer, 3) record your personal belongings and their value for security purposes and add or delete items while keeping the list in tact, 4) record all your phone numbers and then use the system to dial those numbers on your telephone, 5) play chess on the phone with another player and be able to see all the moves on your TV screen.

EXCELLENT BUSINESS TOOL

With these expansion modules, businessmen will be able to do all their bookkeeping functions, payroll, inventory control and billing. There will be printers, telephone modems and a variety of peripheral computer equipment that will turn your Bally Library Computer into a significant business tool. And, when used in your business, your Bally unit is depreciable like all your other capital equipment. Even large corporations can use the Bally for specific applications to avoid tying up their larger computer systems.

The Bally Library Computer will turn these incredible add-on features into reality in a planned program starting now. Each month, a new cartridge or accessory expanding the unit's capability will be announced. If you purchase your system from JS&A, you will be alerted to these new accessories by mail on a regular basis in advance of their availability and before any national announcement. You may then order the accessories directly.

Each new cartridge or accessory will offer you a new way to use your system—a way that would justify, by itself, the purchase of the entire system.

NOT JUST A TV GAME

Don't confuse the Bally Library Computer with the many inexpensive programmable TV games. The Bally computer is a powerful system using the Z80 microprocessor whose cost per byte (the measure of computer memory power) is even lower than a home computer. Yet it has 12,000 bytes of computer power in its most basic system and you are not just limited to teaching, music, entertainment or business applications. The Bally computer can be programmed to do anything any mini-computer can do. A programmable TV game at any price is (and will always be) just a programmable TV game. It cannot be expanded. The Bally Library Computer is actually a computer with a variety of expansion capabilities.

A COMPUTER IN EVERY HOME

This is the first time a full-scale computer has been offered to the consumer. The home hobbyist with his home computer started the revolution a few years ago. With the specific programs, software and accessories available

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from Bally, the age of affordable consumer computer ownership is here now.

INTERNAL TASK LIBRARY

The computer you buy now has within its 34 integrated circuits an internal library of over forty tasks that it performs. With such an extensive internal library, your computing power is already in the unit you buy. This also means that the Bally unit is a smart computer. (There are such things as dumb computers.) A smart computer can complete a function faster and more efficiently because it depends less on the data it gets and more on what it can already do.

SAFE FOR YOUR TV

The task library includes a built-in electronic timer which determines the end of a game or program by either score or elapsed time. It also times the arcade games and automatically turns off your unit and blanks out your screen if it is left on too long. Most TV set manufacturers have excluded sets that use TV games from warranty coverage because of the possible lines that appear on the screen from sets left on too long with the same picture. This is impossible with the Bally.

If you get a phone call in the middle of a game, you press the pause control which lets you freeze the action right in the middle of a play and blanks out the screen so you won't damage your picture tube.

The library has sound effects so that each arcade game is complete—from the sound of a baseball bat to that of a torpedo hitting a submarine. It has a math program capable of turning your unit into a scientific, statistical or engineering calculator with the addition of the appropriate cartridge. The library contains the capability of creating patterns on your TV screen, playing music, and accepting typewriter entries. It even has an index that displays everything in your library.

The cassette cartridges add between eight to thirty-two thousand additional bytes of computer power to the basic 12,000 byte system. The pistol grip arcade accessory can be used to play all the arcade games.

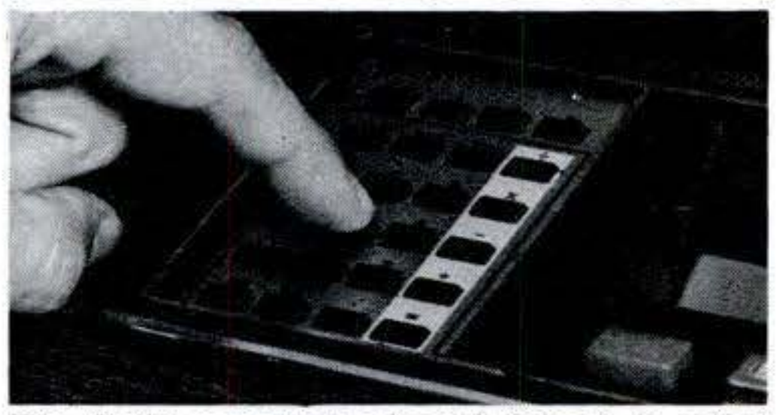
THE MAJOR BREAKTHROUGH IN BALLY'S COMPUTER

Its extensive internal library and the tremendous power in the computer are the big breakthroughs in the Bally unit. The internal computer has over 12,000 bytes with a minimum of 8,000 bytes in its cartridges. This puts more computer power in the hands of the consumer than six typical programmable TV games or an average hobbyist home computer. It has the computational capabilities of one $10,000 IBM 5100 computer, and each time you add a cassette cartridge you increase that capability.

Good resolution on your TV screen is one of the end effects of so much computer power. By comparison, the best programmable TV game image is projected on a screen composed of 64 dots wide by 64 dots deep or 4,096 total dots. The Bally unit is 160 by 100 or 16,000 dots—four times more—so the Bally image is sharper and has finer detail, better resolution, smoother motion, and clearer letters for math or text applications.

SIGNIFICANT EXPANSION MODULES

The most significant expansion accessory will be the dual magnetic tape decks with an alpha numeric (typewriter) keyboard. With this accessory package, which will cost under $500 and be introduced by JS&A next year, you can record data and software programs and do everything you can do on any mainframe computer system within the data storage capacity of the Bally unit.



The Bally console keyboard is used to select specific programs from each cassette.

The implications of this add-on module are mind-boggling. First, it adds an additional 16,000 bytes of memory to the powerful 12,000 already in the basic system. Secondly, it provides not only more power and features than are presently available in any home computer, but it contains peripherals that would normally cost thousands of dollars extra and are considered accessories on all other mini-computer systems. Thirdly, it uses the computer basic language which is easy to understand. And finally, each cassette tape in the system will contain an additional one quarter million bytes of storage capability. With the tape decks and keyboard, the consumer will now own the equivalent of an entire computer system complete with peripherals, storage and memory.

HIGH SPEED PRINTER

A quality high-speed printer will also be available next year. This will give you written records from your storage tapes. Store your most frequently called phone numbers, your income tax figures, your savings account deposits, the value of your stocks and bonds or a net worth statement. Then, when you need the information, press a button for a printed record.

DIAL-A-BARGAIN® ORDERING SYSTEM

Our technicians have programmed JS&A's main computer so you can use the Bally to access our computer directly when Bally's dual tape decks become available. With a special module and cassette, you will be able to 1) call our computer on our toll-free number, 2) place an order, and 3) find out when it will be shipped. Since you communicate directly with our computer, your order is processed immediately and can be shipped within a few hours after receipt. To do this, JS&A engineers developed a $100 hardware ordering package that will be sent free to those customers who order the basic unit this year.

THE BIG DIFFERENCE

When you order the Bally computer today, you are making an investment in the future. The basic unit you receive, without a single accessory, will provide more benefits than any other product of its kind in history.

When you buy an expensive product, you must be absolutely satisified that you get the service and a solid company standing behind your purchase for many years to come. The Bally Library Computer is backed by a substantial company, Bally—in business since 1931 and now the world's largest manufacturer of coin-operated amusement games. JS&A is America's largest single source of space-age consumer products and also a substantial company—further assurance that your investment is well protected.

A FRANK DISCUSSION OF SERVICE

The Bally unit is a solid-state computer with its electronics condensed on 34 integrated circuits—all hermetically sealed and all pre-tested for a lifetime of service. The Bally Computer is also self-diagnostic. We have developed a cartridge that lets the unit itself check every integrated circuit and every solid-state component and which displays any malfunction on your TV screen. Then all you do is send the circuit board or your entire unit to JS&A's service-by-mail center for prompt replacement. The cartridge will be sent free-of-charge only to JS&A customers after you receive your unit.

Please don't think service requirements are common. They're not. But we wanted to assure you that service was such an important consideration in the Bally design that the unit practically repairs itself.

COMPLETE AS IT ARRIVES

Each unit comes complete with four pistol grips for use with the arcade and teaching games, an AC adapter (batteries are not required), three free arcade games, the calculator program, its internal library of tasks, complete easy-to-understand instructions and a one year parts and 90 day labor limited warranty—all for only $299.95.

The arcade games include 1) Gun Fight, in which two cowboys shoot at each other around cactus, covered wagons and other obstacles, 2) Checkmate, a one to four player game in which you build walls around your opponent to win and, 3) Scribbling, a one to four player game that utilizes the pistol grip to droodle different designs on your TV screen (in color with a color set).

A keyboard lets you use your printing memory calculator and a special scroll button lets you scan your entries up or down to review or check your calculations. You may also order with your unit the Baseball and Paddle Games cartridge for $24.95 or the Math Table/Math Bingo cartridge for $19.95. A bulletin will accompany your unit listing all the other cartridges and accessories that are available or will be available in the near future.

We feel so positive about this product that we will 1) not charge you anything for postage and handling and 2) give you a 30 day extended trial period to prove that the Bally is everything you expected after reading this article. When you receive your unit, reconcile your checkbook with the calculator, let your child practice with the math programs or have your entire family play the arcade games. After you have used the system under your own conditions and have personally experienced its fun and benefits, then decide if you want to keep it. If not, return it within our 30 day extended trial period for a prompt and courteous refund. You can't lose.

JS&A is marketing a product that will not only greatly influence the future of the computer industry, but will dramatically add consumer conveniences never before dreamed possible. Order your Bally Library Computer, at no obligation, today.

Unit pending FCC approval—allow 4 weeks delivery.
Dial-A-Bargain is a registered trade mark of the JS&A National Sales Group.

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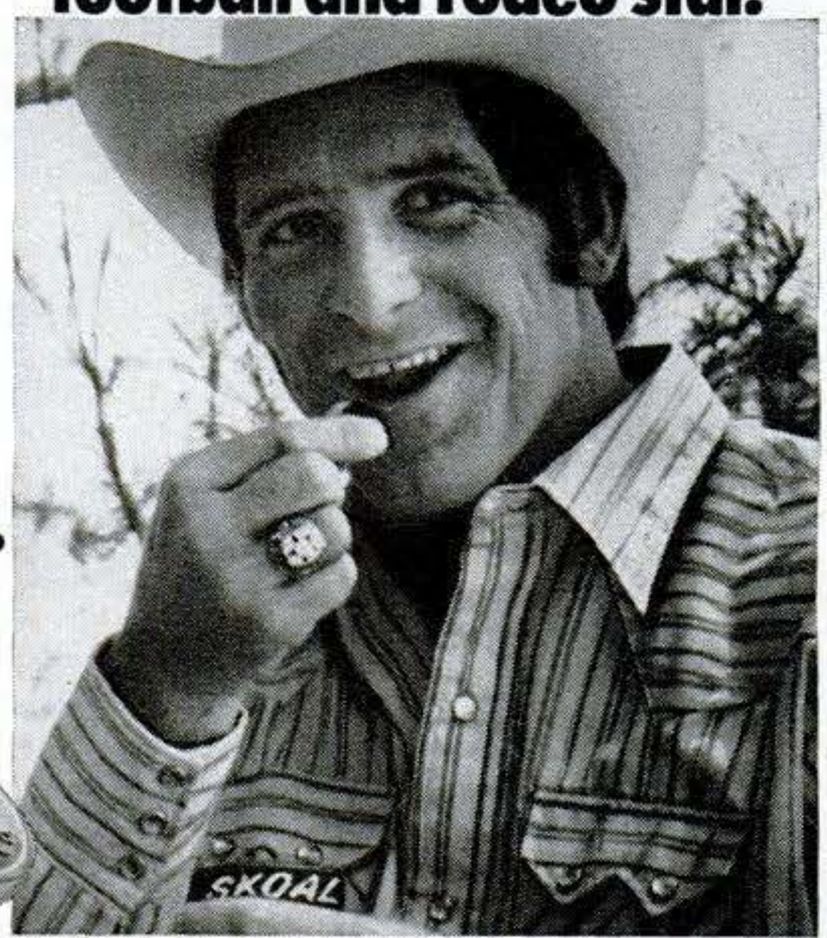
I love tobacco. I don't smoke.

Walt Garrison, football and rodeo star.



You don't have to smoke to enjoy tobacco. All you need is a pinch of "smokeless" tobacco between your cheek and gum. You'll get full, rich tobacco pleasure.

Look for it in three great brands. Skoal. Copenhagen. And Happy Days. Each is dated for freshness.

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For a free booklet that explains how to get the full enjoyment of "smokeless tobacco" —as well as a few free pinches that you can try for yourself—write to "Smokeless Tobacco," United States Tobacco Company, Dept. PS107, Greenwich, Conn. 06830.

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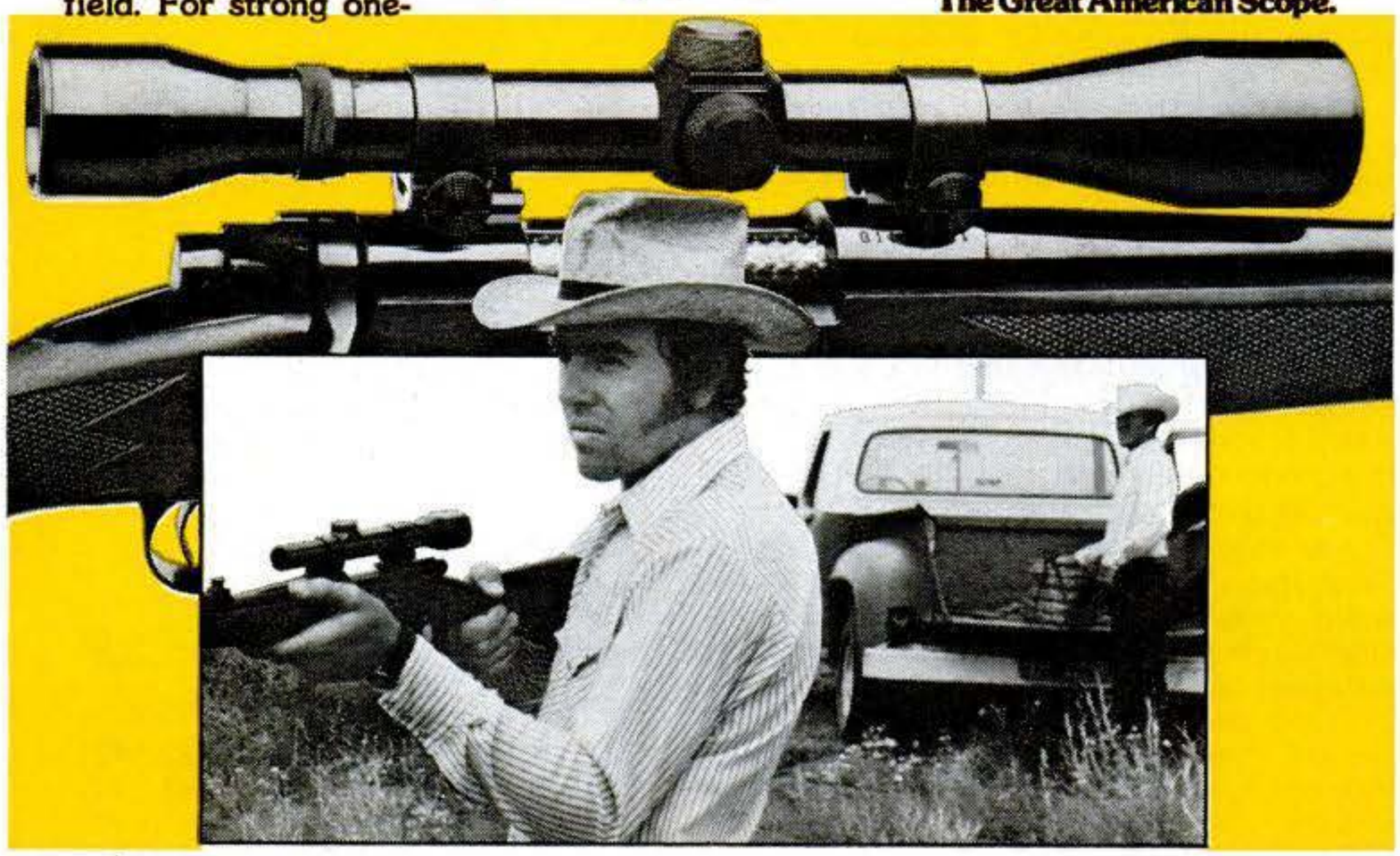

levels are not set below the suggested two-grams-per-mile level.

Fuel economy is the outstanding feature of the diesel; long life is another. Dodge claims that the diesel will deliver 50-percent better fuel economy than a comparably equipped six-cylinder gasoline engine. But outside the cab, the typical rapping noise of a diesel engine can be clearly heard, and at idle speeds you can detect a trace of diesel odor and smoke from the exhaust pipe.

General Motors has taken a different approach in its diesel program. The 350-cu.-in. V8 diesel offered in the Chevy and GMC pickups for the first time is the same engine Oldsmobile developed for its 88 and 98 sedans. Chevrolet has it in the C10 two-door pickup, the same vehicle that GMC markets under the C-1500 label. With a ½-ton carrying capacity, the two pickups have plenty of power for any job in their 5300-6200-lb. gross-vehicle-weight rating. Acceleration is similar to that of a small gasoline V8, and noise levels, both inside and outside the cab, are very low for a diesel. At idle, you can barely hear the sound of the underlying diesel "rap." Like the Dodge diesel, smoke and odor are minimal at idle, and practically undetectable at higher engine speeds.

Among the reasons for introducing a V8 diesel, Chevrolet cites engine smoothness, a 22-percent improvement in fuel economy, lower service requirements (though oil changes are recommended every 3000 miles), and simplified emission controls.

Buyers of diesels are cautioned about the economics of diesel driving by each of the companies. The diesel is most economical for high-mileage driving—20,000 miles or more a year. City drviers who use a diesel for short trips and drive less than 10,000 miles a year get few advantages. PS

DIESEL ENGINE SPECS	Chevrolet/GMC	Dodge
Engine type	V8	Inline 6
Source	Oldsmobile	Mitsubishi
Displacement —cu. in./cc	350/5.7 liter	243.3/4 liter
Horsepower	120 @ 3600 rpm	103 @ 3700
Torque	222 @ 1900 rpm	168 @ 2200
Transmission	3-speed automatic	3-speed automatic, 4-speed manual
Compression ratio	22:1	20:1
Bore	4.057	3.62
Stroke	3.385	3.94
Fuel	#2 diesel oil	#2 diesel oil

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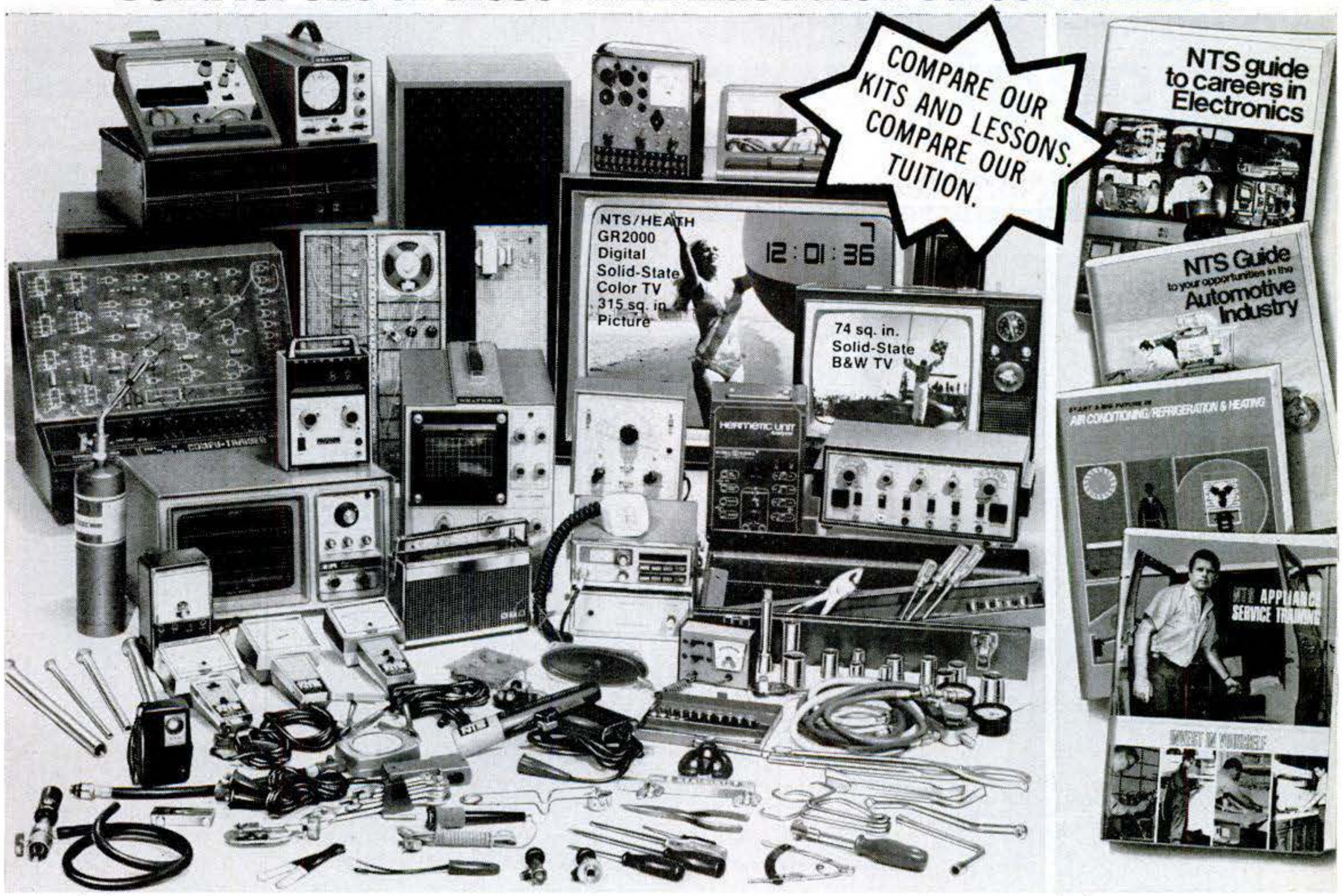
Send for one of these FREE Illustrated Career Guides:



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ELECTRONICS DIVISION: Courses include professional equipment like 5" solid-state oscilloscope, transistor and tube-tester, vector monitor scope, 74 sq. in. B&W TV, and solid-state stereo AM-FM multiplex receiver, speakers. Color TV courses feature advanced NTS/HEATH DIGITAL GR-2000 Color TV with silent varactor diode tuning; digital read-out channel selection (with optional digital clock), big 315 sq. in. screen.

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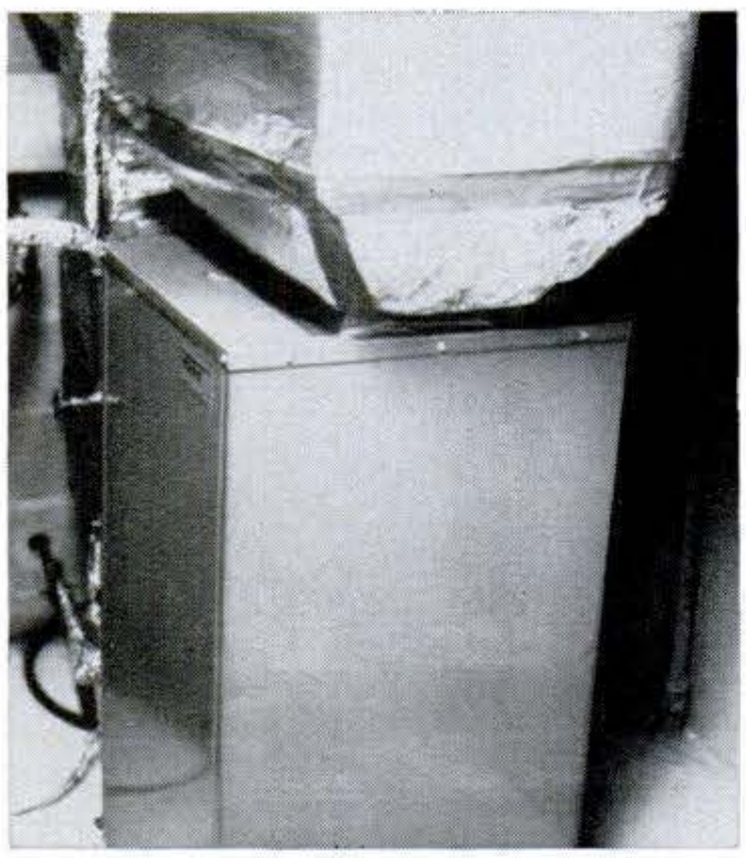
ADVENTURES IN ALTERNATE ENERGY

A monthly sampling of projects PS readers have devised to conserve or replace fossil fuels

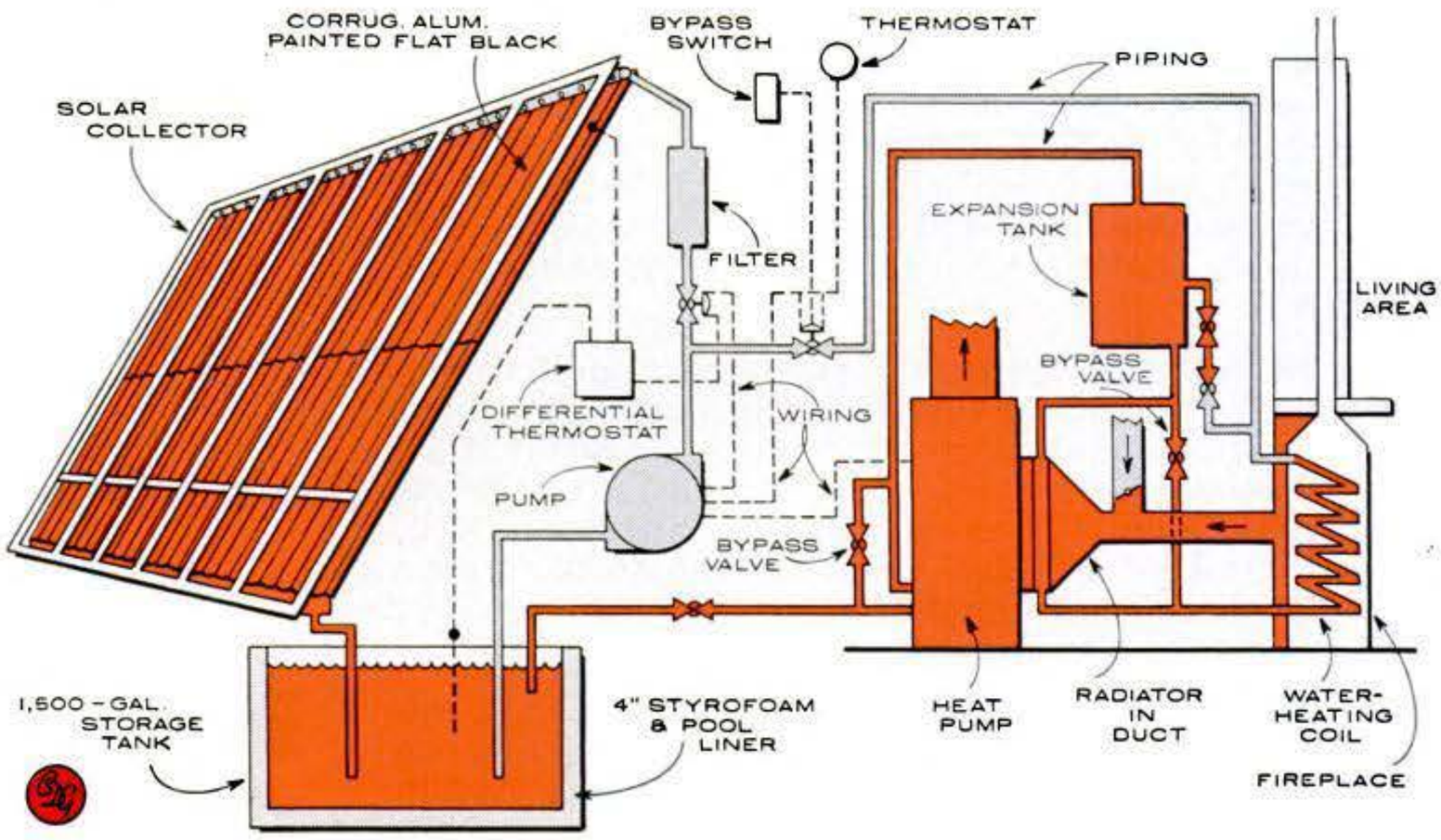
David and Cynthia Edney: Solar-assisted heat pump

Dave Edney monitors all gauges and meters twice a day, for continuous-performance data. Edney reports solar-collector efficiency averages 60 percent.



The 280-sq.-ft. aluminum trickle collector dwarfs Cynthia Edney. Heat pump (above) is capped with insulated duct. Piping at rear brings water to and from water-heating coil in fireplace.

By EDWARD MORAN



Belfast, where this house is located, is on northwestern New York's "cold shoulder"—that 7000-degree-day blizzardy tract abutting Lakes Erie and Ontario. Last winter, the Edneys spent an average of 85 cents a day to stay warm in the 1128-sq.-ft. house they built themselves with selected professional help.

The *house*, complete with $7200 worth of solar and wood-heat equipment, cost Dave and Cynthia Edney about $25 a square foot. That's the going rate for a lot of solar *collectors* these days, like the ones in the "world's most advanced solar home" [PS, July]. Dave, a mechanical engineer, and Cynthia, a chemist, are convinced that a well-designed, energy-efficient house is not an impossible dream for young couples (he's 30, she's 28).

So how did the Edneys end up heating their home for $26 in January of That Winter of '77? By a judicious mix of domestic technologies, both in overall design and in the heating system itself. The house is a single-floor ranch style with two bedrooms and a family room. It's slab-on-grade, except for an excavated 12-by-12-ft. basement; a 24-by-30-ft. garage/shop is attached.

The walls of the house (post-and-beam construction, with no interior load-bearing walls) are six inches thick. The roof, nearly flat to maintain an insulating snow load in winter, has aluminum sheeting to reflect heat in summer. And it's got six inches of insulation. Grape vines planted around the west-facing porch (great-grandma knew how to keep her cool) re-

Continued

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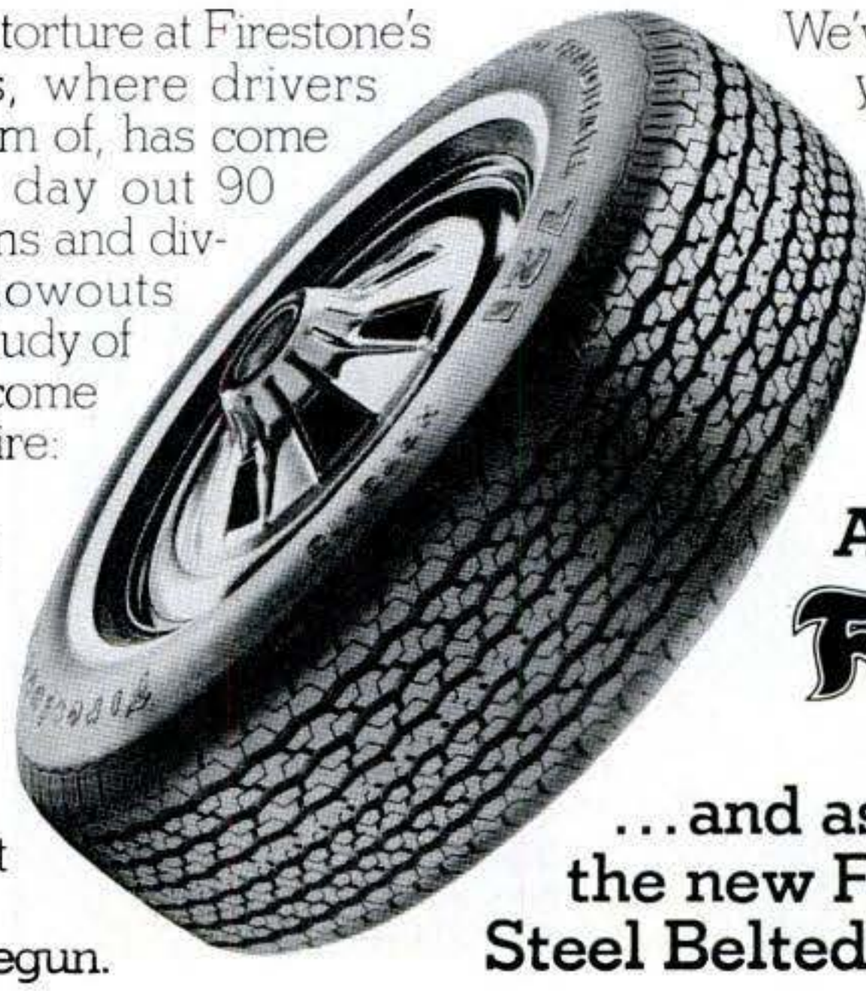
From five million miles of testing and torture at Firestone's Developmental Proving Grounds, where drivers do things to tires you shouldn't dream of, has come a special new tire. From day in, day out 90 mph speeds, from slamming into turns and diving into water, from deliberate blowouts and long agonizing hours of careful study of test after test...from all of this has come Firestone's finest steel belted radial tire: the Firestone 721.

Why did 721 steel cord come on so strong? It uses ten strands of steel, where five were used before. And we've wound it differently than before. With seven strands around two strands, and one other wrapping up the pack...the new twist that gives our tire its name.

Our journey's over, yours has just begun.



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Ask a friend about Firestone

...and ask your dealer about the new Firestone Steel Belted Radial 721.™

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[*Continued*]

duce heat gain on summer afternoons. The garage and shop are on the north side to shield the living area from harsh winds. A "closed-door policy," an old but oft-forgotten trick, zones heat into living areas in winter: The family room, for example, is self-contained, with wood stove and spring water for use under extreme conditions.

There are three major components to the Edneys' heating system: a York solar-assisted heat pump; the flat-plate trickle collector that supplies the pump; and a backup fireplace, complete with outside venting and water-heating coil.

The heat pump extracts heat from the solar-heated water and supplies that heat to the forced-air system using a refrigeration cycle. The process is reversible to provide cooling in summer. When water temperatures are between 45° and 85°, the heat pump comes on line. Above 85°, the house is heated directly by water through a radiator in the forced-air duct (see diagram); below 45°, the fireplace supplies auxiliary heat.

The fireplace is equipped with heavy metal doors that can be closed for good draft control. Air preheated around the firebox supplements the heat pump, and water from the coil is pumped to the solar storage tank to replenish the supply, or can be used for domestic hot water. The fireplace supplied about 16 percent of the total heat requirements last winter. Its combustion air is supplied from the outside, a sensible setup: Why waste indoor air you've paid to heat when the fire could do just as well with colder air?

The drain-down collector on the south wall is corrugated aluminum sheet painted flat black and double-glazed with acrylic, with four inches of Styrofoam insulation behind. Water trickles over the 280-sq.-ft. collector at a rate of 25 gpm and flows into a below-ground 1500-gal. concrete tank that provides about two days' storage.

The Edneys estimate that it would have cost $284 to heat their house with an electrical-resistance system last winter. "This gives us a system C.O.P. (coefficient of performance) of approximately 2.33," they say.

The table below indicates performance data for the last heating season. To ask a specific question, send a stamped return envelope to the Edneys, c/o Belfast Specialties Co., P.O. Box 501, Belfast, N.Y. 14711. PS

Performance data 1976-1977

Month	Collector run. time (hr.)	Monthly heat requirement (Btu)[1]	Degree days in month	% heat supplied by solar[2]	Operating cost of system[3]
Dec.	87.5	6,799,360	1328	84	$26.79
Jan.	128.5	7,823,360	1528	80	28.96
Feb.	141.1	5,002,240	977	96	28.50
Mar.	145.3	3,527,680	689	100	21.05
Apr.	72.4[4]	2,370,560	463	100	16.72

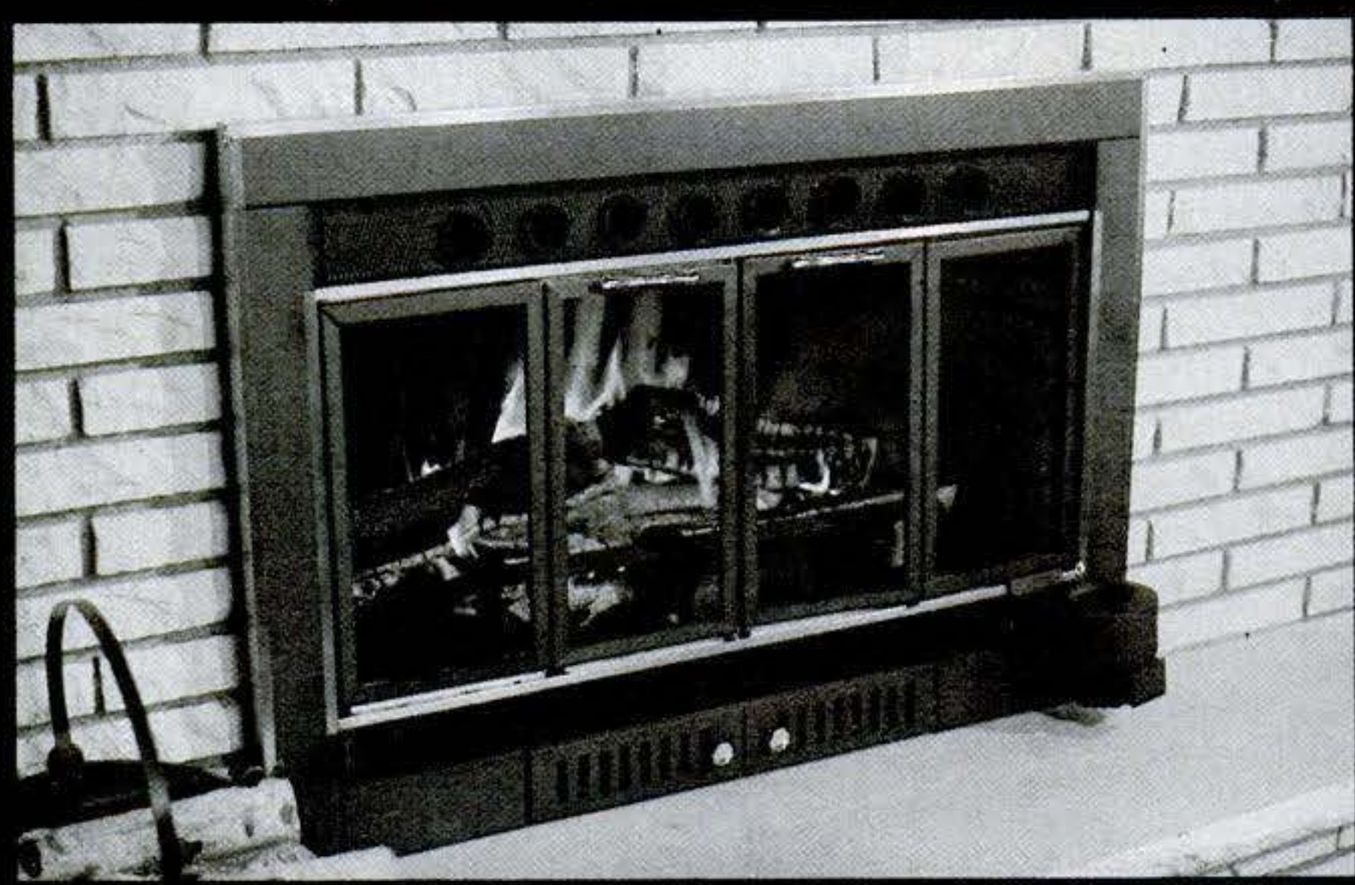
[1]House heat loss at −10° ≈ 5120 Btu/degree day

[2]Total hours of auxiliary heat required, divided by hours in month

[3]Figured from electric meters on heat pump and water pump, and from hour meters, based on electric rate per kilowatt hour

[4]Reflective aluminum covers were installed on April 13, when storage temperature reached 145°. System was shut down from this point, except for the heat pump. Covers will be in place until early October; heat will be provided from storage or from the fireplace until then.

Fight rising fuel bills



Glass Door Thermograte® unit converts fireplace to circulating heater. Boosts output 10 times!

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Put your fireplace to work. Dynamic Thermograte breakthrough cuts heat loss, can deliver up to 100,000 BTU/hr. — "enough to heat a house".

Performance & quality guarantee.

Enjoy the cozy charm of an open fire with the elegance and safety of glass doors. Add draft control to your fireplace and cure all smoking problems. Burn any solid fuel.

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"THE ORIGINAL" tubular fireplace grate dramatically increases heat output so you save on fuel costs. Open fireplace models available in 35 sizes.

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The Marlin 336.
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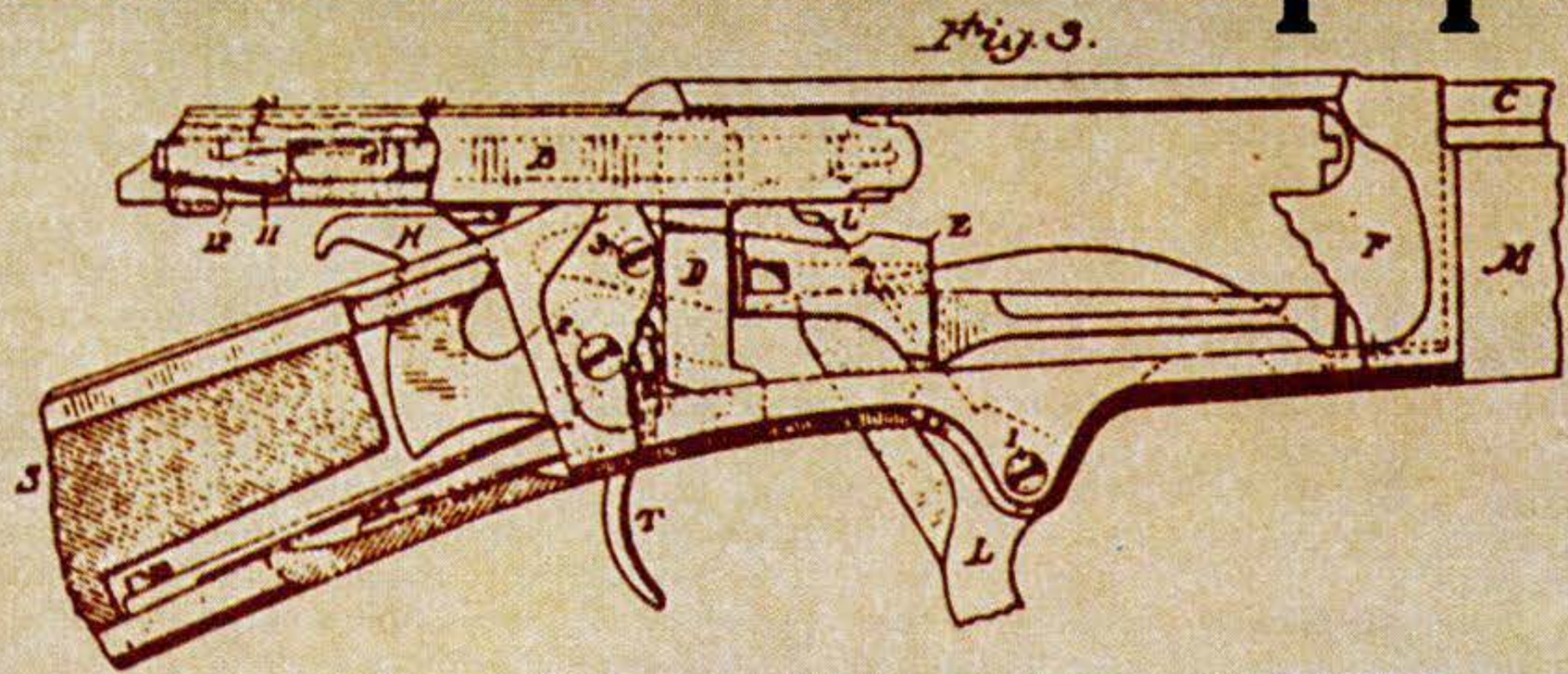

Then it went down in history.

About 83 years ago, we sold our first Model 1893.

The guy who bought it must have been pretty pleased. cause word started getting around. Before we knew it, we l one of the hottest selling, most popular rifles ever built.

Today, after more than 8 decades and only slight modifi- ions, the legend of America's premier deer rifle continues in Marlin Model 336. What's made it such a great gun is all great things that go into it.

A simple, fast action, with six critical parts machined n solid steel forgings, then heat treated for added strength l durability. An adjustable folding semi-buckhorn rear and np front sight with Wide-Scan™ hood. A solid top receiver h side ejection for low, centered scope mounting. A genuine nerican black walnut stock. And Marlin's famous Micro- oove® rifling. And today you don't have to settle for just one version of the 336. Now there are 3 to choose from.

The 336C with pistol grip in .30/30 Win. or .35 Rem. And the 336A, like the 336C but with a longer 24" barrel, available in .30/30 Win. Or the 336T with traditional straight grip in .30/30 Win.

The Marlin 336, from about $144.95. You pay for a gun. You get a legend. See the entire Marlin line, along with popular-priced Glenfield rifles, at your gun dealer's. Also, ask for a copy of our new, free catalog. Or write, and we'll send you one.

Anyone high school age or younger can win up to $1,000 in the Marlin Hunter Safety Essay Contest. To be eligible, students must be enrolled in, or have completed, a Hunter Safety Course. Write for entry form. Marlin Firearms Co., North Haven, CT 06473.

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Is it good-bye to the op amp?
Cheaper, faster microcircuit

LUTON, ENGLAND

Now there's a faster, cheaper, and more reliable alternative to using an op amp (operational amplifier) in digital and analog circuits. It's called a VCT (voltage-to-current transactor), it's from Texas Instruments, and its general-purpose design makes it a versatile contender for everything from computers to your TV set.

The pin-head size device is designed to fit on an integrated-circuit package. (In fact, two will operate on a standard 16-pin IC package.) But unlike standard operational amplifiers that require a number of various components, the VCT uses only 35 transistors. The lack of resistors and capacitors makes it 100 times faster in operation, more reliable, and cheaper.

Working with Professor William Gosling at the University of Bath, England, Carl den Brinker invented the network theory used by the VCT. "Like other amplifiers, the VCT boosts the signal, but this one converts an input voltage into a current and delivers two completely isolated balanced outputs," he explained to me.

Currents are much easier to add when you want to merge two analog signals, such as those indicating air pressure and temperature in a car engine's fuel-injection system. Since these are high-impedance devices, you can simply parallel outputs on a common resistor to provide a combined control signal. Op amps have low-impedance voltage outputs. You can't add them the same way because they would interact and give false results. Outputs must first be converted to currents, which calls for extra discrete components in the circuit, slower operation, and higher cost.

Flexibility is another big asset for the VCT. By merely connecting its external leads in different configurations, you can make it perform different functions. It can be rigged to make a capacitor look like an inductor (choke, coil, transformer, etc.), in a network called a *gyrator*. That's important for low-frequency filtering, which requires large inductors. "A one-henry, high Q, wire-wound inductor needed to filter out frequencies of a few hertz would be the size of a double-decker bus," says den Brinker. "That can now be done on this tiny microcircuit."

As a simulated transformer, the VCT could have enormous potential for telecommunications, for example. Every domestic telephone needs a complicated hybrid transformer with dummy coils and loads to separate your own loud voice from the weaker incoming speech and make them equal in volume. A VCT arrangement, similar to the gyrator, can do it easily.

Uses for the VCT are endless; it could take over all standard op-amp jobs, and do them more efficiently. This general-purpose chip will likely be made as a half-dozen variations on one design, ready as an off-the-shelf item for any engineering need. Merely changing the pin connections would customize the VCT for any circuit.—*David Scott*

Aircommand 40-channel CB.

From the people who bring you Marantz—the world's finest stereo systems—comes the Aircommand CB-640—the finest in 40-channel CB. With Aircommand you get over 25 years experience in outstanding 2-way communications products.

Full 6 Watts of audio power. Provides plenty of punch so your speaker cuts through freeway noise.

Dual-conversion superheterodyne receiver with dual-cascaded ceramic filters. Together, both features provide the most complete rejection of unwanted signals, assuring you unsurpassed selectivity and sensitivity.

4 big Watts of RF power. Aircommand delivers the maximum power legally allowable to let you belt out the big sound.

100% modulation capability. Even when you talk softly into the mike, your message cuts through loud and clear, thanks to one of the most advanced mike preamp and compressor designs in CB today. With Aircommand, you don't have to spend an extra $30 to $40 on a "power mike." You can't buy better modulation than Aircommand.

Specially tailored frequency response.

LED 40-channel selection display. Easy-to-read, night or day.

8-LED (light emitting diode) meter display. Provides an easy-to-read display of SWR (standing wave ratio), modulation, and incoming or outgoing signal strength—instantly, accurately.

Special emergency Channel 9 scan with exclusive Aircommand "beep" alert. No matter what channel you're on, a special Aircommand CB-640 circuit continuously and silently monitors Emergency Channel 9. When someone starts transmitting on Channel 9, a unique "beep" alerts you, so you can tune yourself in and give assistance.

Public address capability. The versatile Aircommand CB-640 public address package lets you (1.) Talk into the CB mike and out an exterior public address speaker. (2.) Attach a tape recorder to the auxiliary jack on the

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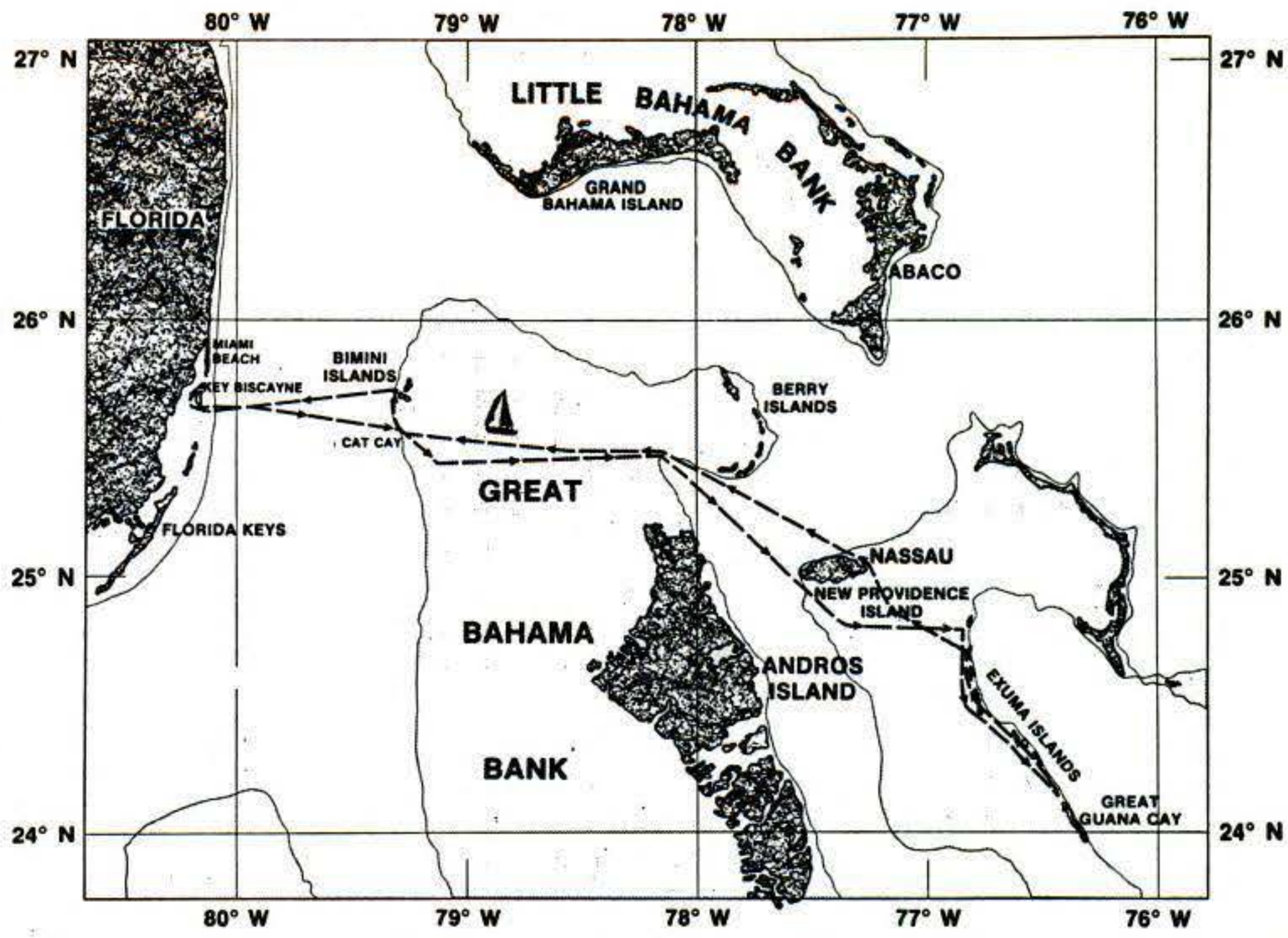
Satellite **boat watch** makes for safe sailing

The legendary Bermuda Triangle has lost its terror—at least for James L. Baker and Louis, Roz, and Peter Van Houton. They recently sailed the 33-foot sloop *Sirius* on a 600-mile journey through those waters. During the 30-day trip, Baker reported the craft's location daily, via satellite, to NASA engineers at the Goddard Space Flight Center.

The *Sirius* carried a small, battery-powered transmitter that broadcast a continuous signal. Nimbus-6, a meteorological satellite, relayed the signal from the *Sirius* to a computer at Goddard. (From its polar orbit, the satellite tracked the *Sirius* for 3½ hours at noon and again at midnight.) About 40 percent of the time, the position of the boat reported by the satellite was within a mile of its true position; overall accuracy was within three miles.



For specific messages, Baker used a push-button unit. This relayed craft identification, weather conditions, and simulated distress calls to Goddard via the satellite. Once actuated, the push-button unit automatically repeats a distress call. The whole system is compact enough to be moved to a lifeboat.

While the experiment proved that satellites can track small craft at sea, it had a more immediate impact on the crew of the *Sirius*. Baker summed up their feelings: "It was comforting to know that Goddard had up-to-date information on our position and cruising conditions, particularly since we were in the notorious Bermuda Triangle."—*Susan Renner-Smith*

.You never heard it so good!!!

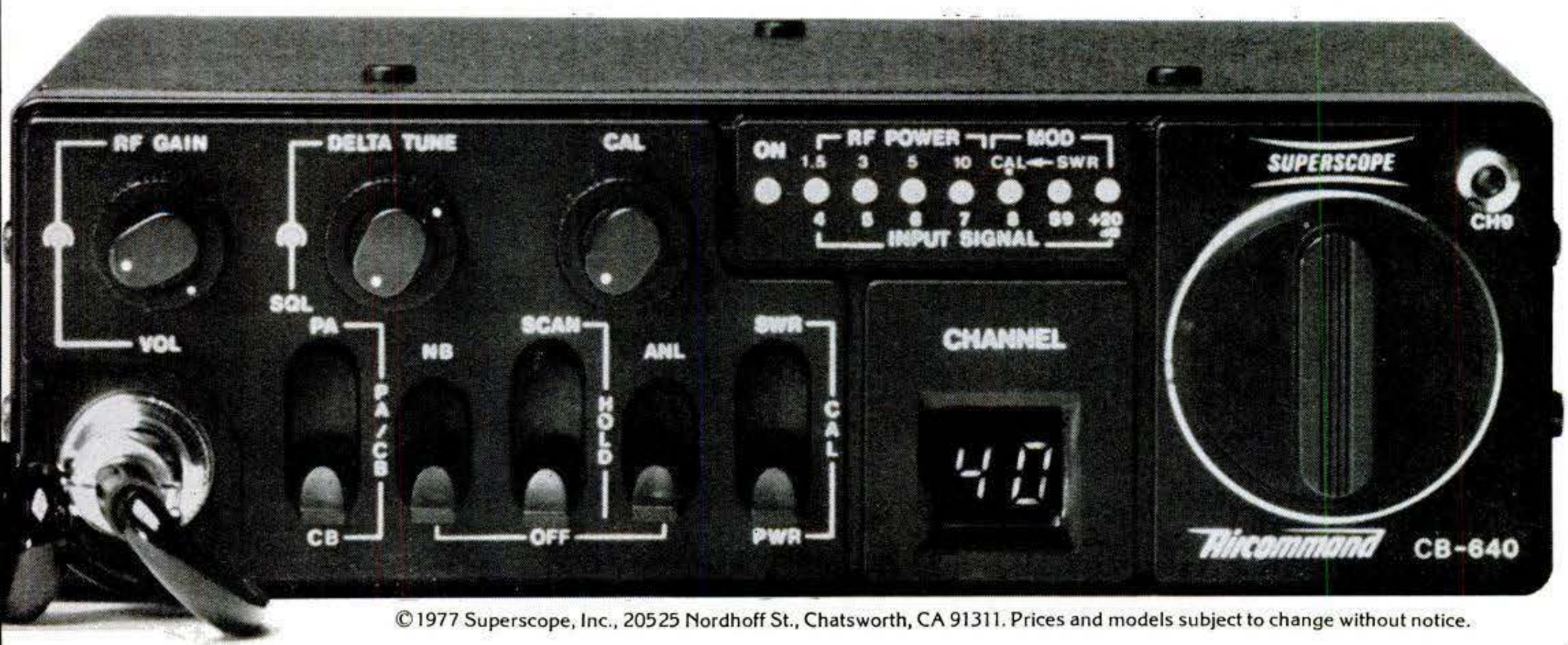
CB-640 rear panel, and boom your tape out through the same external speaker. (3.) Mix your voice from the CB microphone with the program material on the tape recorder. Both voice and tape sound at the same time through the external speaker. (4.) Beam your **received signal** through the external speaker.

Built-in standing wave ratio circuitry. Measures the efficiency of the antenna system for optimum performance.

Other outstanding features include: Delta fine tuning control, digital synthesizer with phase-locked loop, automatic noise limiting switch, noise blanking switch, squelch control, RF gain control.

Also available: Aircommand CB-140; Aircommand CB-340. All 3 units bring you state-of-art design, flawless craftsmanship and day-in, day-out reliability. Try them out now at your Superscope Aircommand dealer.

TM Aircommand by SUPERSCOPE.



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Marlboro

18 mg. "tar," 1.1 mg. nicotine av. per cigarette, FTC Report Dec. '76

Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

Popular Science

PS | What's News

I'm convinced that we are about to witness a genuine revolution. And we don't see too many of those.

I'm referring to the computer revolution. We're all pretty used to the idea of computers. But we think of them as being used by banks or big corporations or by NASA to compute spaceflight trajectories. We're going to have to change that way of thinking. Starting now, computers are for you and me.

Prices are coming down, computing power is going up. A new breed of machines with computing ability formerly reserved for big business and scientific computers is appearing on the market. And they're selling for prices you can afford.

In this month's cover story, electronics editor Bill Hawkins, who has been living in a house totally run by several computers for months now, reports on the new machines.

The new low-cost machines are just becoming available as you read this. So we had a problem last July when we had to shoot the cover photo for this issue. We finally decided to feature the PET computer, so we dispatched art director Herb Anthony to Palo Alto, Calif., where the Commodore company (manufacturer of PET) is located. Herb hired photographer Don Cameron and got ready to take a cover photo. But how could we get across the idea quickly, right on the cover, that this was a home computer? The answer: shoot it in a kitchen. Don made a deal to make use of the showroom of Kitchen 'N Karpets in Palo Alto. The story starts on page 30.

Hydropower to the people

Back in April, President Carter asked the Army Corps of Engineers to look around the country and see how many small dams could be rigged up to produce electricity. The answer, we hear—although the report has not been released as of this writing—has astonished energy planners.

Without really looking too hard, the Corps reported it had located 48,000 dams that were good power-site candidates. If they were rigged up with turbines as outlined in our May cover story, they could produce as much power as all the big hydro plants now operating across the entire country. They'd have an astonishing 30-*million* kilowatts of generating capacity and could grind out enough energy for nine million people—enough to keep New York City going.

Exactly what the government is going to do about this is not yet clear, but several Congressmen are now talking about bills that would make money available to companies or individuals and pay up to 75 percent of the cost of small hydro plants built as demonstration projects. Small water plants could be important, say the experts, not only because they could generate a lot of power, but also because they cost a lot less per kilowatt of generating capacity than coal or nuclear plants and because they're far less damaging to the environment.

Keeping Kennedy cool

People seem to keep coming up with ingenious ideas for saving energy. You may remember that this column reported on the work of Doctors W. B. Harris and R. R. Davidson of Texas A&M about three years ago [June, '74]. They had an idea for storing summer heat in an underground water reservoir called an aquifer, then using it to heat homes in the winter. During winter, the water would gradually cool as its heat was extracted, and then it could be used for air conditioning in the summer.

Now, ERDA has announced that a contract will be let to put a similar project into effect to cool passengers and employees at New York's giant John F. Kennedy airport. Several wells will be drilled to reach an aquifer known to be beneath the airport. In winter, groundwater will be pumped through cooling towers where it will be thoroughly chilled, then pumped back into the ground. In summer, it will be pumped out and run through cooling coils for air conditioning. Pumping costs will be a fraction of what air conditioning costs now; engineers say it could reduce the number of kilowatts needed for cooling by a whopping 90 percent.

News on the geothermal front

There aren't many places in the world where hot water or steam that can be tapped for geothermal energy exist naturally under the earth. But there are a lot of places where dry, hot rock can be found within drilling range of the surface.

In 1971, researchers at Los Alamos Scientific Laboratory devised a scheme to drill two holes deep into a hot rock formation, then pump water in at high pressure [PS, Aug. '72]. The water would crack the rock between the holes, forming many channels where water could trickle through. Then water could be pumped down one well and back up through the other. The heat energy extracted from the rocks could be used to drive a turbine and generate electricity.

Researchers have now drilled two 10,000-foot holes near Los Alamos and begun pumping. The rock cracked exactly as predicted, and the water coming out is at 265° F. There is enough heat being extracted to run two 10-megawatt electrical plants, which will be installed soon. If this system works as expected, ERDA would like to drill another pair of holes to 12,500 feet, where the rock would be hotter and the energy production consequently about four times as much.

And while Los Alamos scientists work to find new geothermal sources in the West, there's activity in the East, too. Dr. James C. Bresee of ERDA's Geothermal Energy Division says that large reservoirs of hot water may lie waiting to be tapped near Savannah, Charleston, Baltimore, Jersey City, and perhaps other areas. The energy is trapped in granite layers that contain considerable amounts of thorium, a naturally radioactive substance. The gradual decay of thorium releases the heat that has been building up in these granite layers about a mile beneath the surface for millions of years. Since the layers are also saturated with water, they should make ideal geothermal resources.

If the now-preliminary studies continue to be favorable, geothermal test wells could be drilled at some time in the relatively near future.

C P Simon

Executive Editor

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GM for '78

–the intermediates are smaller

New intermediates are about a foot and a half shorter and 650 pounds lighter than previous models. Cutlass, above and left, comes in four basic body styles: four-door sedan and wagon, two-door coupe, and Supreme coupe, left, which has unique styling and roofline.

Subcompact Chevette gets a five-door hatchback. Wheelbase is three inches longer than the coupe's for more rear-seat room and easier entry and exit. Base engine is now 1.6 liters.

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By JIM DUNNE

The most important new developments at GM for '78 are in the intermediate line. Chevrolet's Malibu and Monte Carlo, Pontiac's Le-Mans and Grand Prix, Buick's Century and Regal, and Oldsmobile's Cutlass and Cutlass Supreme have been completely re-engineered and made much smaller. Other important technical innovations for the new model year include a new Olds V8 diesel and a new V6 from Chevrolet.

Following the same format as last year, when the full-size cars were shrunk, the new intermediates are much smaller on the outside than their predecessors, but the same size on the inside. The new A-body cars are about a foot shorter than last year's models, are lighter by 650 pounds, and as a result squeeze more miles from each gallon of gas than the older models. (Fuel economy has improved from one to three miles per gallon.) Di-

Continued

Chevrolet Malibu, above, features a notchback roofline in coupes and sedans. Base engine is Chevy's all-new 200-cu.-in. V6. A 231 V6 and 305 V8 complete the engine lineup. The El Camino pickup, based on the Malibu, is once again available. In both four-doors and coupes, the rear-window lift mechanism has been eliminated to save weight.

Buick Century coupes and sedans share their rooflines with Cutlass. Regal shares its notchback roofline with the Cutlass Supreme. Turbo Regal features a turbocharged 231 V6 that gives V8 power with V6 gas mileage. Extra sound deadener makes Century line quieter than other A-bodies.

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Interior room in Pontiac LeMans, as in all A-body intermediates, is the same as in '77 models, despite smaller exterior size. Later in the year, Pontiac will begin making a Grand Am version of the LeMans coupe and four-door, with wider tires, different suspension. Firebird remains virtually unchanged in its ninth season.

Changes in Camaro include soft body-colored front bumper and a new taillight treatment. A snarling and super-handling Z-28 option is once again available.

Popular Pontiac Grand Prix, though changed radically in appearance, is as luxurious as ever It shares its body shell with the Monte Carlo.

Luxurious Chevrolet Monte Carlo looks more like its predecessor than any other redesigned GM intermediate.

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mensional changes also include a six-inch shortening of the wheelbase to 108.1 inches, and a three-inch narrowing of the track to 58.5 inches front and 57.8 inches rear. Smaller, 14-inch tires are now used, and chassis and drive-train parts throughout the car have been shrunk as much as possible.

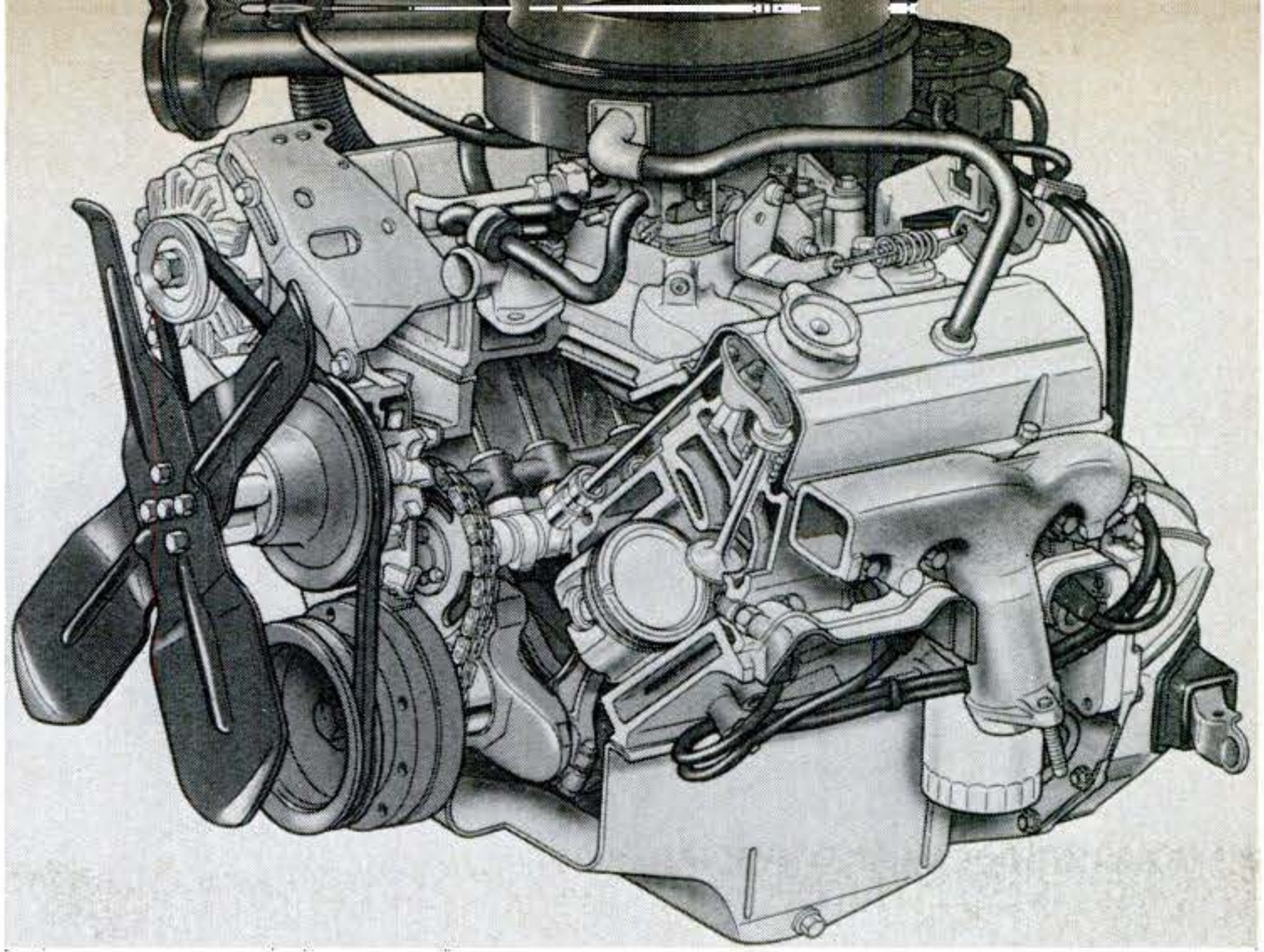
In spite of this tremendous size decrease, the new intermediates match the interior room of the older models in every dimension except hip and shoulder room (2.5 inches less in the new models). Since interior comfort was of utmost importance to the A-body engineers, they added to the feeling of roominess by increasing the window area. Beltlines were made lower, and forward visibility over the short, low hoods is much better than before. When you look out, you feel as though you're sitting in a small car, but a glance around the interior makes you think you're in an old-size intermediate—just what the engineers intended.

To save on weight, the rear-window lift mechanism in all four-door sedans and station wagons has been eliminated and windows fixed in place. (The coupes have had fixed rear glass for years.) To maintain the ventilation that the windows provided on past four-door models, vent windows behind the rear doors swing out. Electrically operated rear vent windows are optional.

GM designers made use of the space usually taken up by the lift mechanisms to build recessed armrests into the door panels. Unfortunately, the armrest is about six inches forward of where the passenger's arm naturally falls, so it is inconvenient to use.

Station wagons have a two-piece tailgate that is split horizontally at the beltline and hinged at the top and bottom. It's a revival of an old setup that is convenient for loading in tight spaces, but it is much more complicated than the single-piece hatch door used on previous models.

For the first time, all intermediate bodies—two-door and four-door sedans, coupes, and station wagons—share a common wheelbase and track. That's the result of a major push for interchangeability among models. Consequently, if you want service for a Grand Prix, you will probably be able to use a part designed for a Chevy or Olds intermediate sedan. Assembly lines that build all four makes will also be easier to manage, with the same-size cars produced continuously.



Chevrolet's 200-cu.-in. V6 uses offset crankpins to achieve smoothness, as on Buick 231. It is derived from Chevrolet's 350 V8 engine.

The smaller bodies called for a new lineup of engines, and the new combinations result in a fuel-economy average of more than 20 mpg for all the intermediates.

The newest engine is a 200-cu. in. V6 that Chevrolet developed. It's standard on all Malibus. The 200 is based on the Chevy 350-cu.-in. V8 design; it's 23 percent shorter in length and weighs 403 lbs., 13 percent less than the 250-cu.-in. in-line six it replaces. The lower weight and smaller displacement, combined with the lighter body it is installed in, make the new V6 Malibu 14 percent better in fuel-economy tests than the 1977 Malibu equipped with the 250-cu.-in. six.

A special balancing design makes the 200 virtually as smooth-running as a V8, both at idle and during acceleration. Throws in the crankshaft are offset approximately 18 degrees to balance the firing interval of the pistons.

Other engines in the 1978 GM intermediate lineup include the revised even-firing Buick 231-cu.-in. V6 [PS, July], which will be available in various models throughout the four divisions' intermediate lineups; the turbocharged 231 available only in the Buick Regal [PS, Sept.]; carryover 5.0- and 5.7-liter V8's; and the Pontiac 151-cu.-in. four (now the base engine in Monza-type models).

As a result of the redimensioning, certain contradictions have occurred in GM's model lineup. The new models are actually smaller on the outside than GM's current compact cars, yet will carry a higher intermediate price tag. Buyers will be faced with the decision of buying a "smaller" GM intermediate car for a higher price. But, if the experience with the highly successful 1977 full-size GM cars is any measure, this should prove no handicap.

Oldsmobile is the leading GM division in diesel-engine development for passenger cars; its 350-cu.-in. V8 diesel will be produced for up to 50,000 Olds 88 and 98 models during the next 12 months. This engine is based on the Olds gasoline 350, and thus can fit under the hood of just about any full-size, intermediate, or compact car built by the corporation, if demand warrants. In addition, the diesel is available in the Chevrolet and GMC light-duty pickup lines (see "Diesel Pickups" in this issue).

In the Olds sedans, the diesel runs with almost the same smoothness as the gasoline V8, though you can still detect some vibration and diesel-combustion rap from inside the car, especially at highway speeds. Olds has outfitted the car with special soundproofing and vibration-damping accessories that help bring its running characteristics closer to that of a gas engine.

Acceleration doesn't quite match that of the gasoline V8, but it is acceptable, and much better than that of most four- or six-cylinder cars. An engine-block heater is needed for starting in cold weather (below −10° F), and oil must be changed every 3000 miles.

The last bit of important news is that the Vega/Astre, along with its 140-cu.-in. all-aluminum engine, has been discontinued. The station-wagon models of these lines will become part of the Monza and Sunbird series. PS

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'78 Chryslers
–goodbye to big cars

By RICH CEPPOS

The changes that you can't see are as important as the ones you can, in Chrysler Corp.'s 1978 model lineup. Some models have dropped from sight, while others are scheduled to appear at a later date. And there are some important internal engineering innovations as well.

Conspicuously absent for '78 are the full-size Plymouth and Dodge, the Gran Fury, and Royal Monaco. They have been discontinued, with nothing new to take their place this year. The reason, according to Robert Kushler, manager of advance program planning: "It's the only way we can meet the federal 18-mpg fleet-average law. We're going to use that production capacity to produce more smaller, fuel-efficient cars." This leaves the intermediate-size Dodge Monaco and Plymouth Fury as the two largest cars of their divisions. They continue virtually unchanged from last year. The Chrysler division, however, will continue to offer its full-size Newport and New Yorker sedans.

Two of the corporation's most important new cars, the Omni and Horizon subcompacts, will make their first appearance around the beginning of the new year. Both cars have the same running gear and are Rabbit-like in design, with a transversely mounted front engine and front-wheel drive.

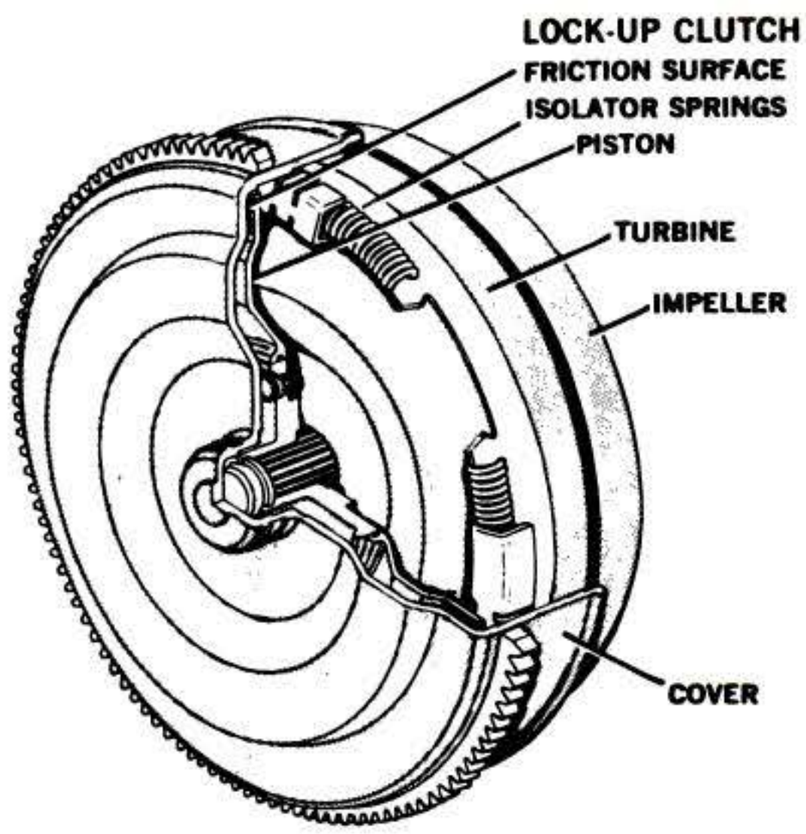
For '78, wagons will be added to the Dodge Diplomat and Chrysler LeBaron lines. They will have woodgrain side panels and luxurious interiors (including a leather option), just as in the sedans.

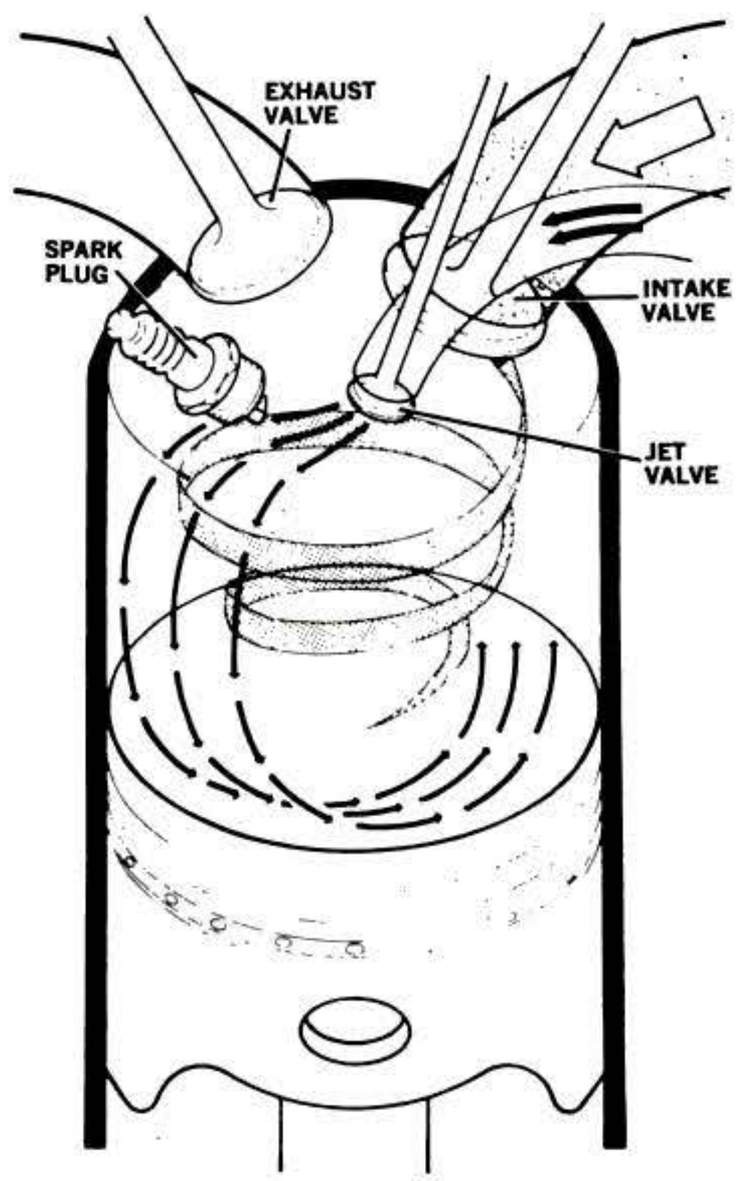
Dodge will also introduce a new car, dubbed the Magnum XE, basically a mildly restyled and sportier Charger. The XE sports a swoopy front end with flip-down clear headlight covers.

Engine availability on domestically built cars is about the same as last year, with V8's of 318, 360, 400, and 440 cubic inches and the venerable 225-cubic-inch six being offered. The electronic Lean Burn system will be used more widely for '78.

Three brand-new subcompacts will appear within days after you read this: the Dodge Challenger, Plymouth Sapporo, and Dodge Colt station wagon. The pictures of the Sapporo and Challenger are still classified as of this writing, but we can tell you that they are both very attractive, Japanese-built, four-seat sporty coupes that have the same body but differ in trim. From the front, the new coupes resemble the Pontiac Sunbird; their rear quarter window and roofline bring to mind the Jaguar XJS coupe; and their rear-window treatment is much like that of the Chevy Impala coupe. The Challenger, sportier of the two, comes standard with alloy wheels and wide tires. The Sapporo is intended to be the more luxurious; it features a cloth interior and a brushed-aluminum roof band. Both have full instrumentation, numerous options, and can be had with four-wheel disk brakes, and either five-speed manual or automatic transmissions.

The Colt wagon is handsome but conventionally designed, and is larger than previous Colts. It weighs 2500 pounds and features very attractive interior appointments and trim. The Colt two-door hardtop has been dropped and only the smaller two- and four-door sedans from





Lock-up automatic transmission eliminates slip in high gear, improving mileage. New MCA Jet engine has a second intake valve that swirls the air/fuel mixture to bring about cleaner low-speed combustion.

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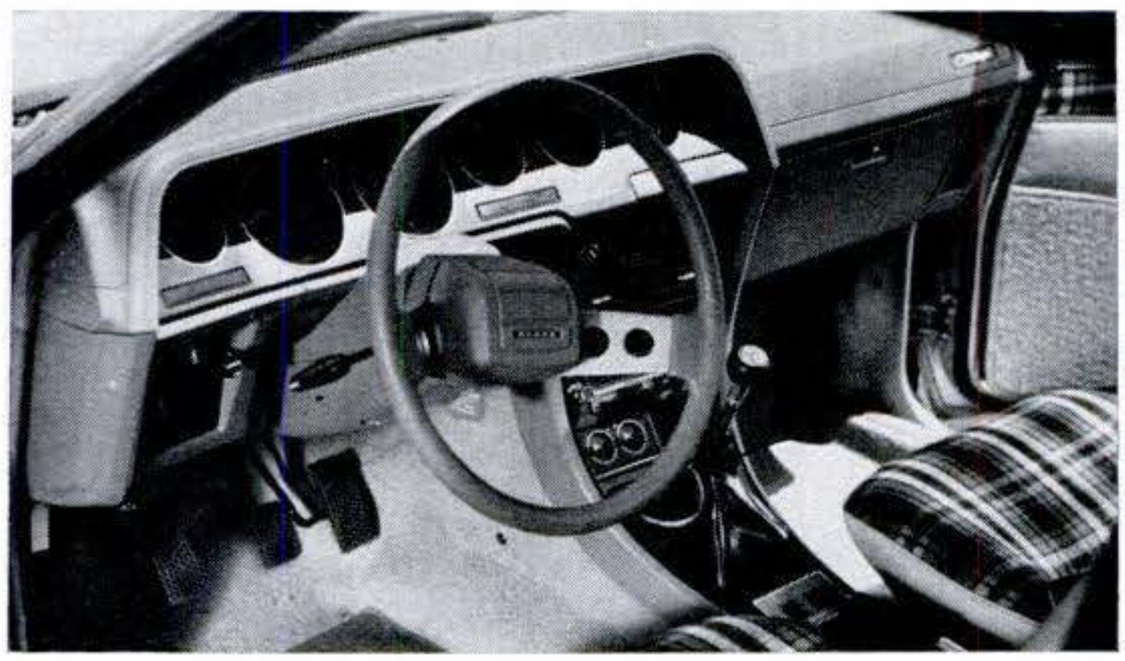
LeBaron station wagon is Chrysler's new entry in the luxury-wagon market. Dodge Diplomat wagon, not shown, is much the same, with wood-grain trim and plush interior (leather is optional). Both are built on Aspen/Volare chassis.

the Mileage Maker series introduced in 1977 remain.

All three new small cars offer the brand-new MCA Jet 2600-cc four-cylinder engine, an innovative design developed to meet emissions laws. At low engine speeds, a second intake valve admits a high-speed jet of air to the combustion chamber, which swirls the air/fuel mixture and promotes quicker and more thorough burning—all of which helps emissions. Curiously, the engine must use a small catalytic converter to meet U.S. emissions standards. The Silent Shaft internal counterweight feature is incorporated into the design, and the engine runs rotary-smooth as a result.

Another important engineering innovation is the "lock-up" automatic transmission. As the name implies, the transmission locks once in high gear to eliminate the inherent six-percent slip of normal automatic transmissions. The new transmission's added efficiency translates into a four-percent gain in highway mileage and a two-percent gain in city fuel economy. In use, I found the lockup process so smooth as to be almost impossible to detect. All automatic transmissions on Chrysler's domestic cars (except those with 440 engines) will be of the lock-up variety.

Other Chrysler Corp. models, including the Plymouth Arrow, Cordoba, Aspen, Volare, Charger, big Chryslers, and Dodge trucks remain basically unchanged for the new model year. PS



Challenger has sporty dash with full instrumentation, plaid cloth seats, and five-speed shift. Challenger/Sapporo will offer 1600- or 2600-cc four-cylinder motors.

Magnum XE has aerodynamic front end, with flip-down covers for headlights. Open Road package, shown, adds stiffer suspension, wide tires, and fender flares.

Full-size models have been dropped at Dodge and Plymouth for '78: Intermediate Plymouth Fury and Dodge Monaco (not shown) will be the largest cars sold by those divisions.

Super Coupe is Dodge Aspen R/T with special paint and stripes, fender flares, wide tires and wheels, window slats, and spoilers front and rear. Engine is 360 Lean Burn.

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AMC for '78

—a V8 for the Pacer, and now there's the Concord

By RICH CEPPOS

The energy crisis and inflation have created a strong market for luxury compacts, says AMC. To capitalize on this trend, American Motors has introduced the Concord, which is based heavily on the aged Hornet series that it replaces.

Although much of the Concord's body is the same as that of the older car, many changes have produced a more luxurious model.

The Concord is offered in four body styles, including two- and four-door sedans, a hatchback, and a wagon; and in standard or D/L trim levels. The standard trim features velveteen fabric in the interior, and the D/L package adds a vinyl roof, reclining seats, a digital clock, and larger tires. Curiously, radial tires are optional, not standard, on all models.

Concord's ride has been improved over the Hornet's. There's more rubber throughout the suspension to isolate the interior from vibration. Front-spring rates were reduced and the shock absorbers were revalved, softening the ride.

To reduce interior noise, additional sound-deadening material was added behind interior panels and door panels, and on the floor under the rear seat. The engineers also found an additional inch of rear head room and two more inches of rear leg room in the Concord—no small feat since the exterior dimensions of the Concord's and Hornet's passenger compartments are the same. The standard engine for the Concord is the 232-cu.-in. six, with the 258 six and 304 V8 optional. And of course you can order your Concord with everything from pinstripes to an AM/FM/CB radio.

The other news at AMC is that the engineers have figured out a way to shoehorn a 304 V8 into the Pacer's already-cramped engine bay (originally designed for a rotary engine). AMC feels the V8 will give the Pacer the added performance buyers are looking for in that type of car.

All other AMC lines, including the subcompact Gremlin, the intermediate-size Matador, and sporty AMX coupe, remain basically unchanged from last years' models except for detail refinement.

Changes to the Jeep line are minimal. The Wagoneer, Cherokee, and pickup get a sorely needed 2½-inch increase in front leg room; the CJ series is treated to an upgraded heater/ventilation system. PS

Grille and V8 engine are new to the Pacer this year. Front end was redesigned to make room for V8 in Pacer's cramped engine bay.

New Concord is more luxurious, quieter, roomier, and gives a smoother ride than the Hornet series it replaces.

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Two new electrics

Among the latest electrics turned out by European manufacturers are these two: one experimental, the other for sale. The hybrid EVR-1 (top) is a rolling test bed for Elec-Traction Ltd. (Heybridge Basin, Maldon, Essex, England). It's a cross between a car and light truck. Its front-mounted 7.5-hp motor produces a top speed of 30 mph. Range is 50 miles on a charge. The plastic-bodied hatchback from Pilcar (Rue François-Perreard 22, 1225 Chêne-Bourg, Switzerland) costs $6400. Its lead-acid batteries have 28 percent more capacity than standard ones, the manufacturer claims. Regenerative braking charges them during deceleration. For easy plug-in charging, a cable pulls out of the nose. The rear-mounted, 22-hp motor gives Pilcar a 55-mph top speed. Range: 70 miles on a charge.—*David Scott*

Rolls-Royce Silver Shadow II

With coffee at $4-plus a pound and the cost of even the basic necessities of life rising out of reach, it's nice to know that somebody out there is trying to hold things down. Rolls-Royce recently proved it cares by introducing a new economy model, the Silver Shadow II. It's the lowest-priced Rolls you can buy and costs a mere $48,000.

I drove the Shadow II in an effort to determine where Rolls cut corners to get the price down so low. I was stymied. The smell of fine leather, not vinyl, greeted me when I opened the door. It appears to be the same stuff used in the $84,000 Corniche convertible and the $104,000 Camargue coupe. And the new Shadow even has an air conditioner that can be adjusted to two different temperatures for the upper and lower vents—a feature heretofore reserved for the Camargue.

The all-aluminum 412-cu.-in. V8, standard in all Rolls-Royces, murmured softly as I launched the 4995-lb. car into traffic. It had power to spare. Shifts from the GM Turbo-Hydramatic transmission were silky-smooth. The Shadow glided silently over the New York streets and was surprisingly agile in dodging potholes and taxis. On the highway, the directional stability and on-center feel of the new rack-and-pinion steering were excellent and reassuring. The steering and front suspension were redesigned this year for more responsiveness because Rolls found that more owners than ever were driving their own cars (things must really be getting rough out there in millionaire-land). The biggest surprise came when I made a U-turn. The Shadow's tight Nova-size 38.5-foot turning radius allowed it to miss the opposite curb by a couple of feet.

So if the Silver Shadow II uses basically the same running gear as the more expensive Rolls-Royces, how come it costs so much less? I don't know. But one thing I can tell you: The Rolls-Royce Silver Shadow II is one very fine automobile —for an economy model, that is.—*Rich Ceppos*

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Our changing weather: Part 2

Colder winters ahead?

Searching for survivors, a Buffalo official checks snowbound cars. Cars had been marooned four days before search began.

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Will this winter be like last year's? Maybe not, but the future looks chill

By GEORGE ALEXANDER

An old-fashioned winter. The phrase evokes images from Currier & Ives prints—skaters waltzing on frozen ponds, horse-drawn sleighs gliding over snowy fields, blazing fireplaces warming snug homes.

Last winter was old-fashioned. But if Currier and Ives were around today, they might have a hard time finding charming scenes to depict. Could they show people trapped in their cars by brutal snowstorms? How about factories closed for lack of heat—and thousands of workers laid off as a result? Or somber Florida farmers surveying frozen crops?

For many of us, such scenes destroy any nostalgia we may have for the winters of yore. Instead we want to know *why* last winter was so severe. Was it just a freak, or does it signal a frigid future?

Last month I reported that studies of both short-term climate patterns (the past 300 years or so) and of long-term cycles (thousands of years) point to the same tentative but harsh conclusion: We've been living in warmer than normal times—and we may have to face an increasingly cold future.

In this concluding article on changing weather, I'll sum up the immediate causes of the past winter's extremes, and review evidence showing that "old-fashioned" winters may be the norm for our climate. And I'll explore new geological findings that suggest we may be moving into another ice age.

Why it happened

Most meteorologists agree that last winter's uncommon cold was caused by the same atmospheric villains that brought drought to the West—a pair of persistent low-pressure troughs, one over the Pacific and the other above New England, that bracketed a high-pressure ridge above the Pacific Northwest [PS, Sept.].

Like boulders dropped in a stream, the ridge and troughs forced the westerly winds to flow around them. Instead of undulating gently eastward, these moisture-bearing winds were detoured far to the north, then deep into the south, drawing polar air in behind them.

As that cold air rolled above the Great Lakes, it picked up moisture —and dropped it almost immediately on the leeward side as snow.

The giant Blue Glacier lurks in Washington's Olympic Mts. Like all glaciers, it's made of unmelted snow that slowly became compressed into ice. The glacier's weight makes it flow; it halts wherever yearly snowfalls tend to melt.

"Now this snow cover was important," explained Jerome Namias, of California University's Scripps Institution of Oceanography. "It enhanced the temperature difference between the land and the Atlantic Ocean. Temperature differences are what storms feed on." And as everyone knows, there were a lot of well-fed storms last winter.

However much of a shock the past winter was to our collective nervous system, severe winters are not as infrequent as our recent weather history might suggest.

By measuring the width of annual tree rings, dendrochronologists at Arizona University's Tree-Ring Lab have compiled a history of the North American climate for the past 300 years [PS, Sept.]. Since the ring widths are determined by temperature and precipitation, they accurately indicate yearly climate. And the long-term picture they paint puts the past winter in a different perspective.

"If you take just the 20th century," said Dr. Terence J. Blasing, one of the lab's meteorologists, "it was a weird winter. But when it's viewed over a longer period of time, it doesn't become quite so unusual. The tree-ring data indicate, for example, that this was the dominant kind of winter in the early 17th century."

Between 1615 and 1655, added Dr. G. Lofgren, another dendrochronologist, there were about 30 harsh winters. No wonder one Pilgrim wrote about the "cruell and fierce stormes" that wracked the Plymouth settlement during the winters of the first half of the 17th century.

The 18th century also had its share of bitter cold. There appear to have been 10 severe winters between 1720 and 1745, and 13 between 1790-1825.

The lesson meteorologists deduce from this climatic history? "If the past is any key to the future," said Harold C. Fritts, head of the tree-ring lab, "then statistically speaking, the calculations indicate cold winters . . . can occur 47-percent of the time, or almost one out of two years in the future."

Return to normal

If this strikes most of us as an ominous change in the world's climate, meteorologists don't agree. "We're returning to normal," said Dr. J. Murry Mitchell, Jr., a NOAA climatologist. "And normal means greater variability in the weather."

Over the eons, scientists have learned, the climate has varied greatly enough to produce periods of tranquil warmth—and of frigid glaciation.

Until recently, most experts thought the glaciers that curled their icy fingers around much of the northern hemisphere had lumbered forward only four times. And, said the experts, each glacial retreat was followed by long, balmy periods, lasting about 200,000 years. But today, a new theory is emerging, based on pieces of evidence gath-

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ered from all parts of the world.

- Central European clay pits: Mucking around in brick clay pits, Czech climatologist George Kukla analyzed soil layers bared by the brick-makers. His findings: warm-weather forests alternated with arctic-like tundra every 10,000 years. These 20,000-year warm/cold cycles slowly built toward a major ice advance in about 100,000 years or so.
- Macedonian peat bogs: Boring deep into these bogs, a team of paleobotanists analyzed plant pollen preserved in the peat. Conclusions: Plants native to warm climates alternated with cool-weather species in 20,000-year warm-cold cycles.
- Coastal coral reefs: Computing the age of coral reefs laid down along the coasts of Barbados and New Guinea, U.S. geochemist Wallace Brocker realized that these terrace-like formations were built by the rising and falling sea. Brocker calculated that glacial melting and refreezing caused sea levels to rise, then fall, every 20,000 years or so.
- The ocean floor: Drilling deep into the sea floor, a number of scientists have extracted cores containing sediments laid down over hundreds of thousands of years. These sea-core samples hold many clues to past climates. They contain radioactive elements from volcanic ash and from seawater itself, which can date the various layers. They are also the graveyards for numberless plankton. These tiny sea creatures reveal the past in several ways. Some coil their shells in different directions, depending on water temperatures. Some species flourish in warm water, and die out in cold; others behave in reverse. And all store valuable trace-elements in their shells: carbon 14, which can be dated, and a rare isotope of oxygen, O^{18}, which is a guide to sea temperatures. (The colder the water, the more O^{18} a tiny shell contains.)

About 10 years ago, U.S. scientist Cesare Emiliani began studying the proportion of O^{18} in Caribbean sea-cores. His findings? You guessed it! A 20,000-year cycle as sea temperatures oscillated back and forth between warm and cold every 10,000 years. The last peak as warm as the present was 100,000 years ago.

The ice age cometh?

Taken together, here's the climate picture these pieces show: About 100,000 years ago, well before the last ice age, it was as warm as it's been during recent history. About 10,000 years later, worldwide temperatures plunged, and stayed cold for another 10,000 years. Glaciers began their snail-like trip south—but the earth warmed up again before they could get too far. The following 10,000 years were mild, but not quite as warm as the last period; and when the cold came, it was more severe. These warm/cold cycles continued, until, at the peak of the ice age (18,000 years ago) glaciers covered about 30 percent of the earth's surface. Then, about 10,000 years ago, there was a sudden shift back to very benign, warm weather, and the glaciers slowly retreated. The last glaciers pulled back from Scandinavia about 8000 years ago—so we may be nearing the end of this 10,000-year "summer."

Although all these pieces seem to fit together, there is one big unanswered question: What causes the periodic warmings and coolings?

> "We are certain now that changes in the earth's orbital geometry caused the ice ages"

There have been many theories. Some experts have pointed to internal mechanisms—long-term transfer of heat and water vapor from oceans to air, or periodic variations in the cloud cover. Other meteorologists have cited external causes: Fluctuations in the sun's radiation; increased amounts of dust in the upper atmosphere from volcanoes and human activity; or changes in the earth's rotation and orbit.

The erratic earth

This last idea was proposed back in the 1920's by a Serbian scientist, Milutan Milankovitch. He theorized that the pull of the other planets, especially Jupiter, caused the earth to stagger in its stately procession around the sun. The earth wobbles on its axis like a giant top, so that over the millennia, it comes closest to the sun at different times of the year. The gravitational pull of the earth's fellow planets also changes the tilt of its axis, so that at times it leans slightly more toward the sun. And the shape of the earth's solar orbit varies, stretching from almost circular to an elongated elipse and back again.

The earth performs these giant dance steps, said Milankovitch, in regularly predictable cycles over thousands of years. And the cycles interact in a complex pattern to vary the amount of solar radiation the earth receives. During periods of lesser radiation, summers are cooler and Northern snows don't melt—but instead start icy glacial buildup.

Since Milankovitch, other scientists have proven his orbital calculations correct. But there was no clear evidence that the earth's orbital cycles caused climate changes.

Last November, however, James Hays of Columbia University made a startling announcement: "We are certain now that changes in the earth's orbital geometry caused the ice ages. The evidence is so strong that other explanations must now be discarded or modified."

Hays heads a group of U.S. scientists working on CLIMAP, an international long-range climate study. The strong evidence Hays cited was gathered from the sea—specifically from two carefully chosen sediment cores extracted from the floor of the Indian Ocean. Hays' group painstakingly analyzed both the remains of plankton in each sediment layer, and the O^{18} levels. Then they used computers to compare the data with other known chronologies. The result? The first unbroken record of climatic changes stretching 450,000 years into the past, three times further than any other record has gone.

Circumstantial evidence

The geologic record shows three different cycles of major climate change over this vast span of time, and the peaks of each cycle match up almost exactly with the known cycles of the earth's orbit. According to Hays, this precise match is more than a coincidence.

The shortest cycle of climate change read in the sea cores was 23,000 years. This matches the earth's precession, or "wobble" cycle. Ten thousand years ago, the earth's giant shudder brought the northern hemisphere closest to the sun in July. Now, our closest approach comes in January. This could make for cooler summers—and glacial growth.

The second major cycle found in the sea cores peaks about every 41,000 years. That's the same time it takes for the earth to sway through a two-degree change in the tilt of its axis. About 9000 years ago, the earth reached its maximum tilt toward the sun. Today the earth

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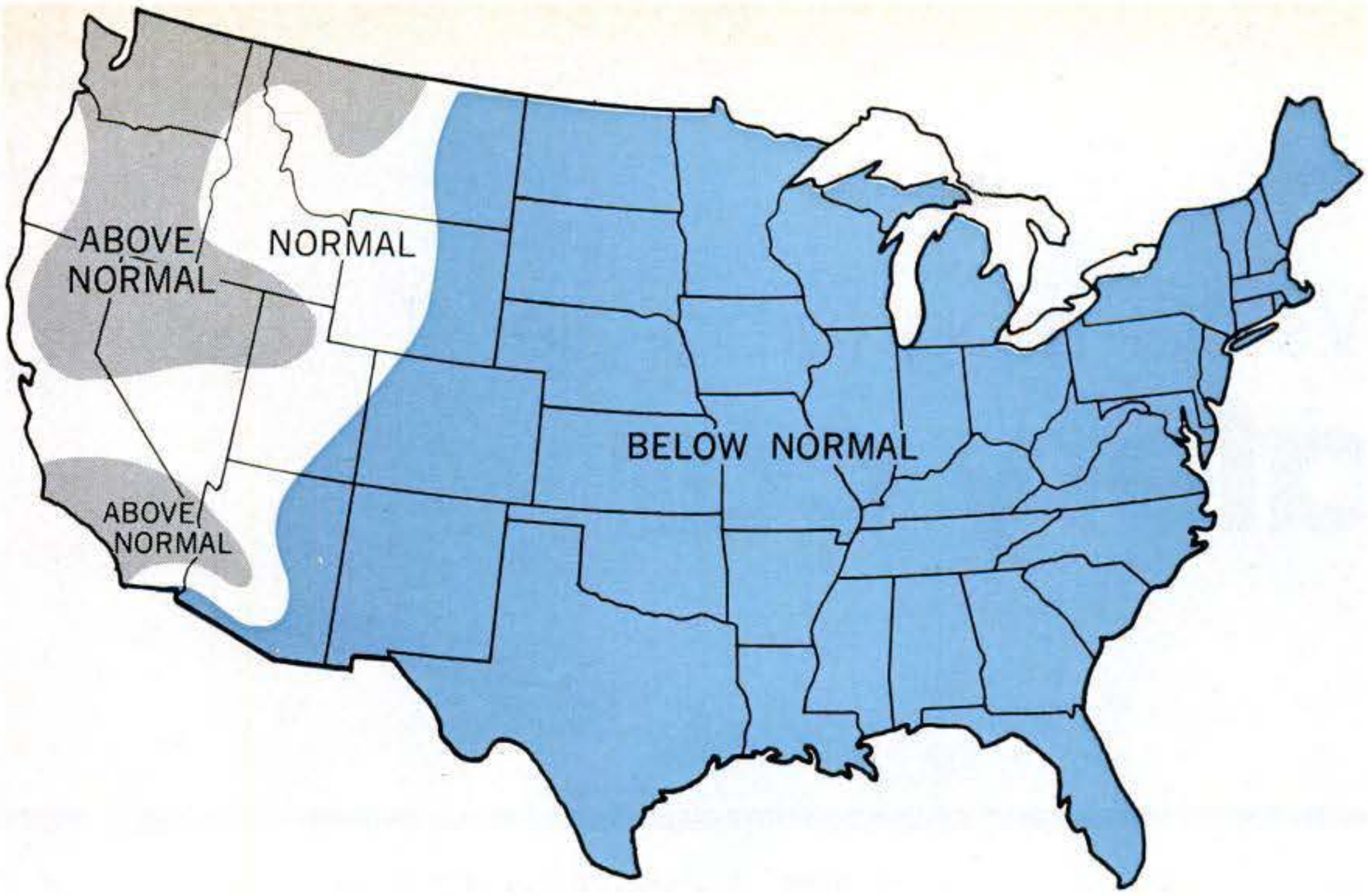
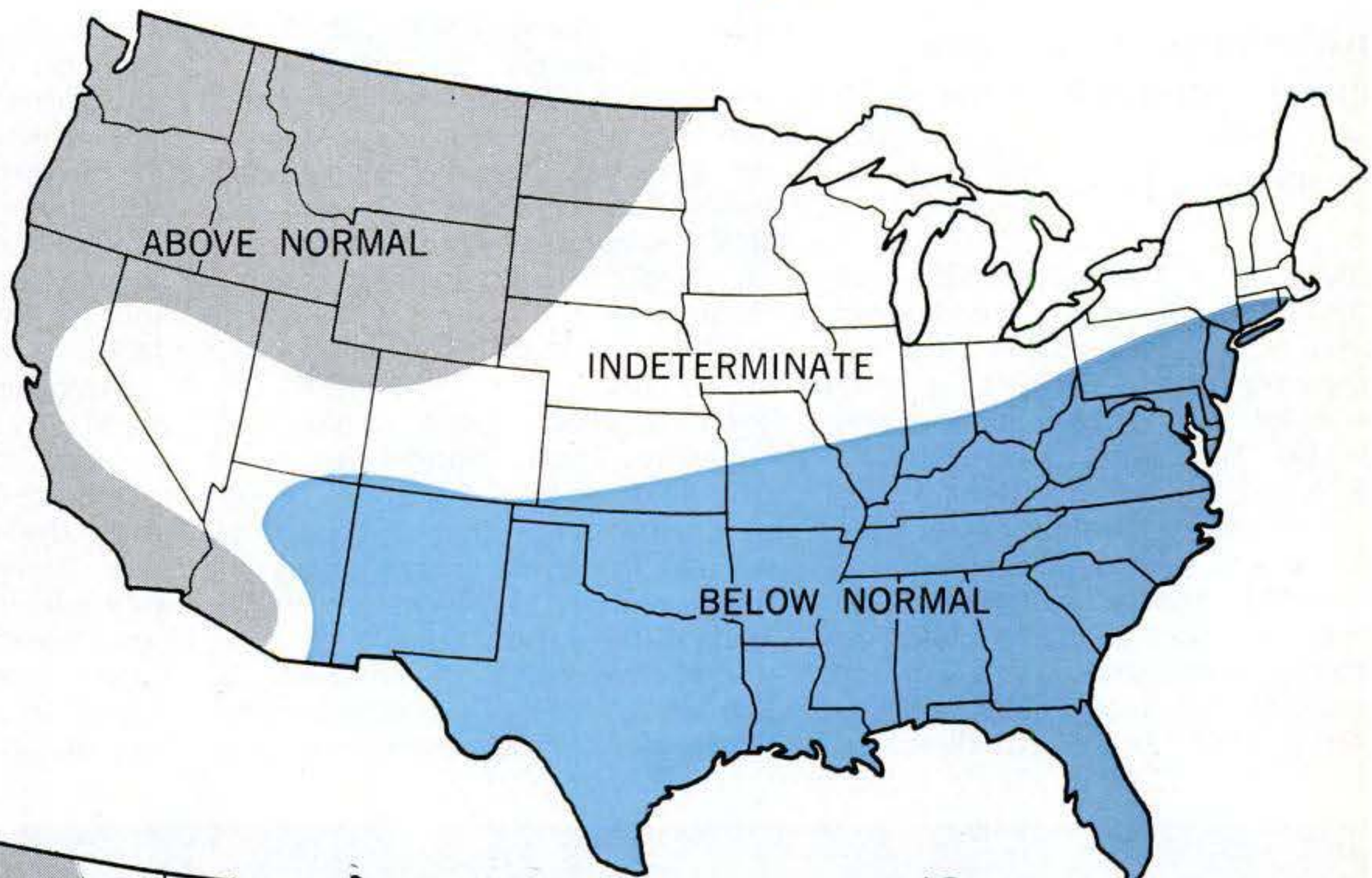


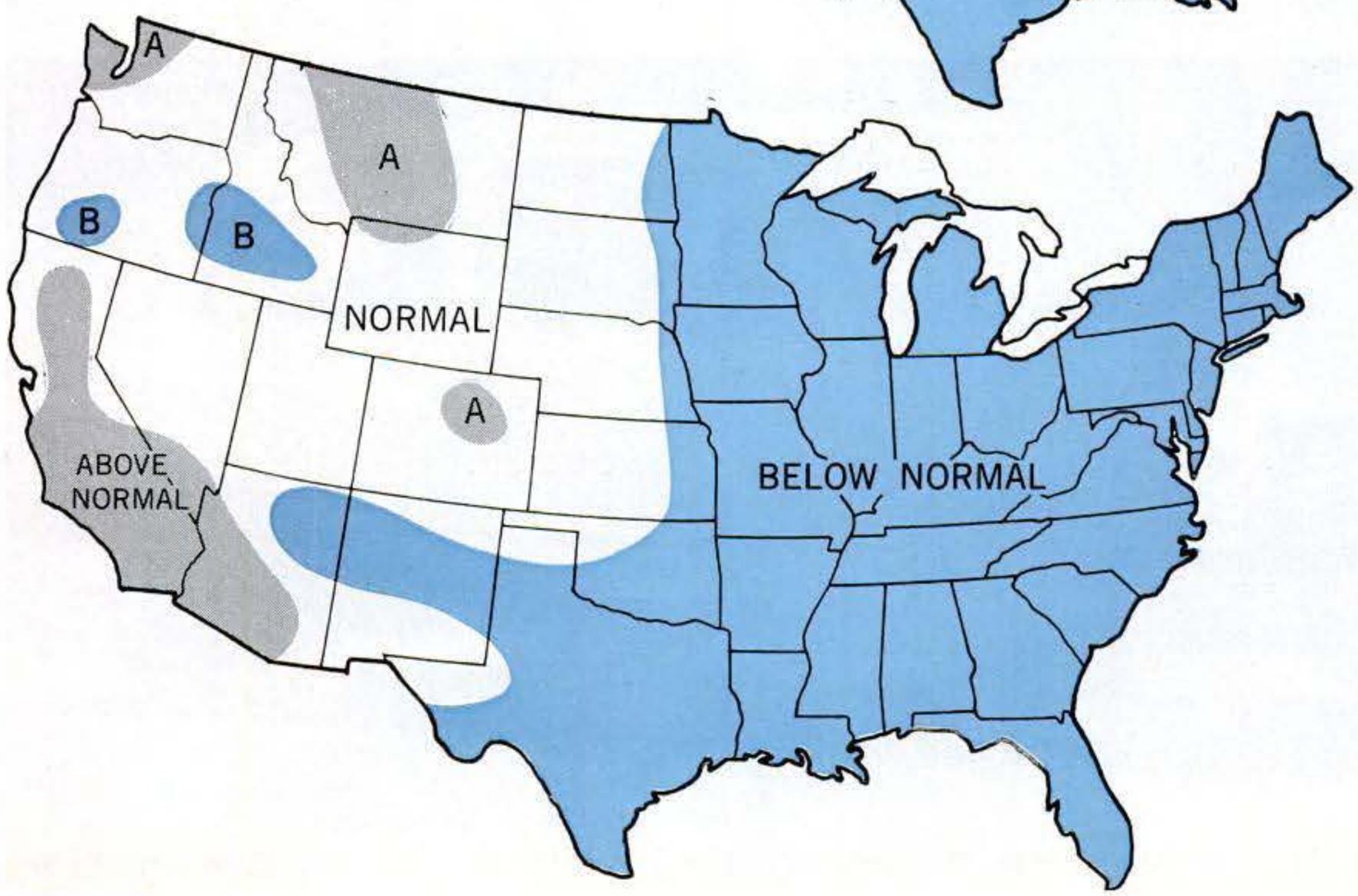
Autumn '76: unusually cool weather

For most of the U.S., chilly days came early in the fall, and lasted through the season. The map shows the average mean temperatures for September through November, 1976. Below-normal readings signaled the bitter winter to come.

Forecast for a cruel winter: November 29, 1976

Based on the cool fall, the Long-Range Prediction Group drew this picture of the coming winter: The basis for comparison: 30 years of "normal" temperatures. "Indeterminate" meant the readings might be either above or below normal.





Winter '76-'77: forecast fulfilled

Last winter's actual averages show that the forecasters came pretty close to the mark (if you count the "Indeterminate" areas.) This means that fall temperatures might well be accurate heralds of the winter ones to come.

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VW's 60-mpg turbo-diesel safety car

Crashworthiness, high mpg in a small package—the shape of things to come?

By JIM DUNNE

Your car of the future will probably be smaller than the one you drive now. It will also be safer and more fuel-stingy. In fact, it could be a lot like Volkswagen's experimental Integrated Research Vehicle.

Built on a Rabbit body, this lightweight prototype of the car of the 1980's boasts an incredible 55-mpg city fuel economy, and can protect passengers in a 40-mph head-on crash into a solid wall.

Still, its turbocharged diesel engine is adapted from the diesel now offered in the Rabbit; the body is essentially the same as that of the present Rabbit; the five-speed manual transmission is a component that VW has been eyeing for production for some time; and the IRVW's safety techniques involve no great technological breakthrough.

VW built the IRVW at an estimated cost of $500,000 for the U.S. Transportation Dept.'s National Highway Traffic Safety Administration. It is one of a group of experimental cars that NHTSA is testing to meet energy-conservation, safety, and environmental goals of the future.

The five-speed transmission is the key to IRVW's fuel economy. Fifth gear has an overdrive ratio of 0.75:1 which allows the engine to run 25 percent slower than 1978 Rabbits. Thus, the fuel-stingy diesel attains fuel economy that would make a sheikh shudder—69 mpg on the highway, 55 in the city, and a combined EPA rating of 60 mpg. (EPA figures for diesel Rabbits now in showrooms are 52 highway and 39 city—a combined rating of 44.)

Performance has not been ignored. A turbocharger that starts to boost at 1200 rpm and reaches full boost at less than 2000 rpm gives the car a 13.7-second 0-60-mph time—and compares favorably with the 13.5-second time of a gasoline-powered Rabbit, one of the fastest economy cars on the road today. In a short test drive, I felt the added punch of the turbo-

Safe, fast, and fuel-stingy IRVW averages 60 mpg, protects passengers in crashes of up to 40 mph without air bags.

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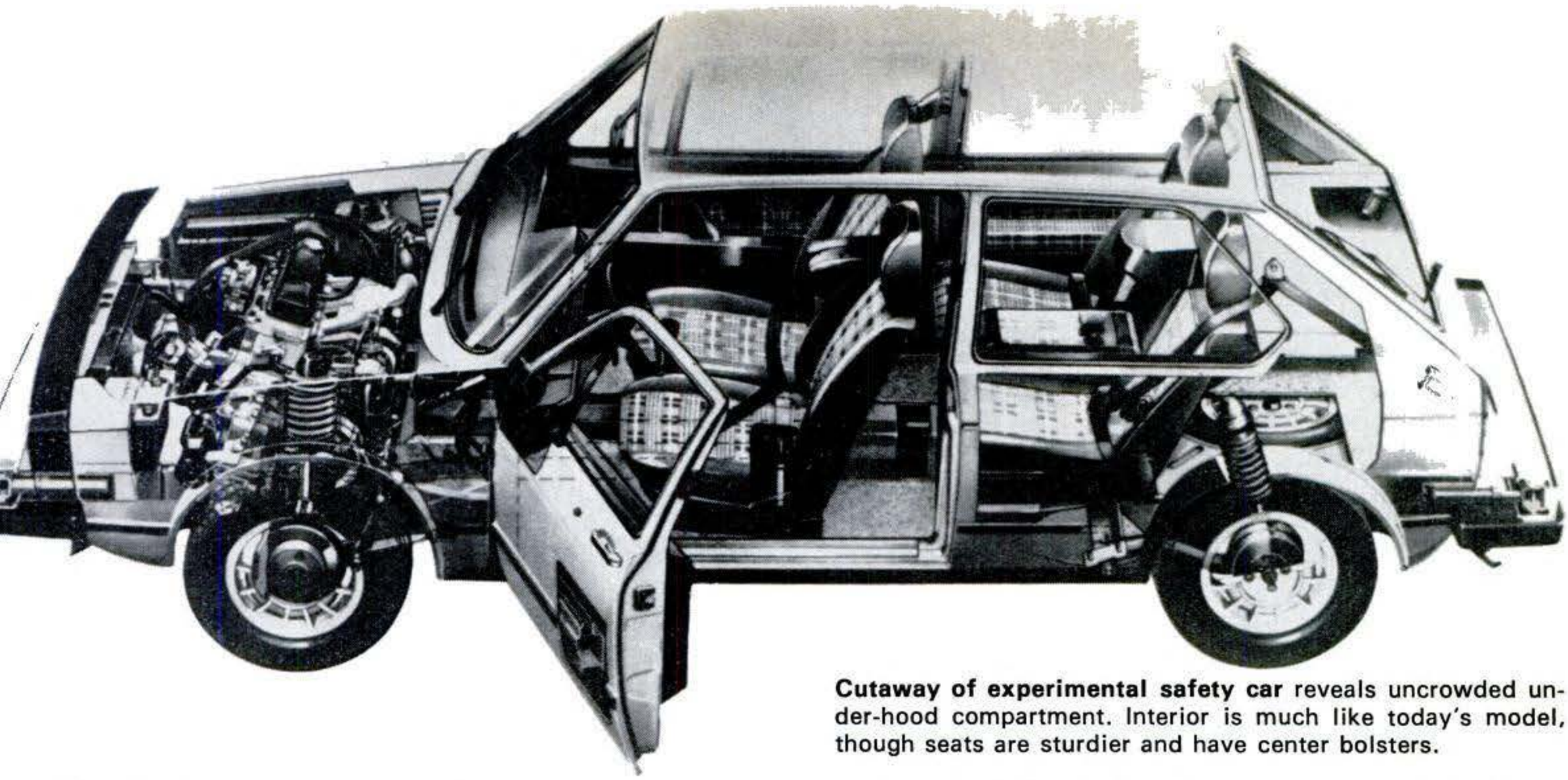
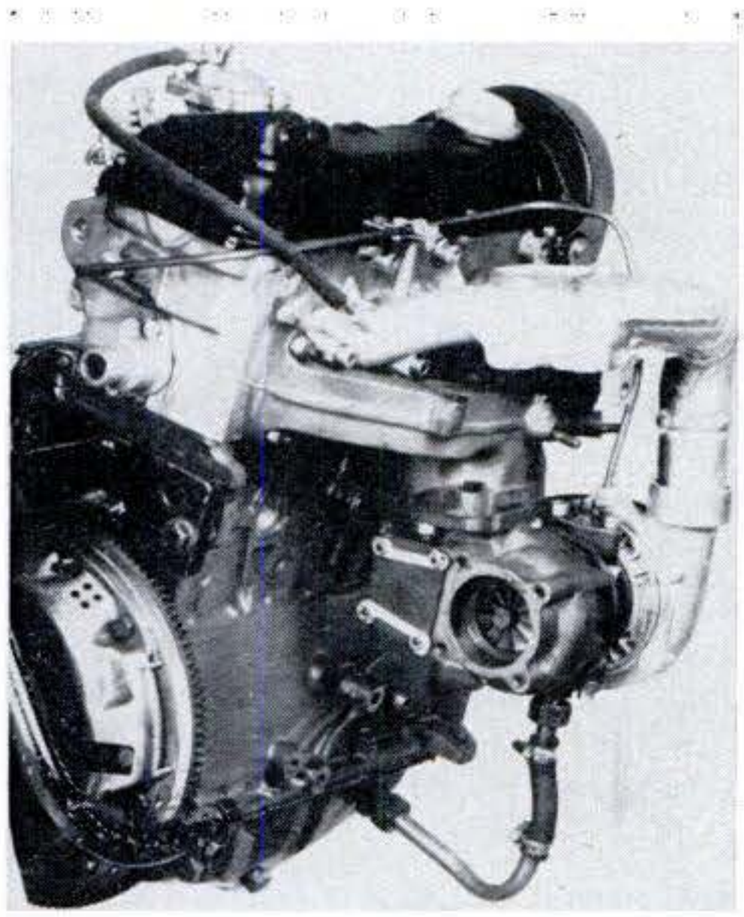


Cutaway of experimental safety car reveals uncrowded under-hood compartment. Interior is much like today's model, though seats are sturdier and have center bolsters.

charger at very low speed. Power output increases noticeably as the turbo cuts in. Once past 1800 rpm, the engine has all the characteristics of a pre-emission gasoline type. I wanted to stay in the lower gears longer than normal, just to maintain high-speed operation, and I was assured by VW experts that this would not hurt the engine. A built-in limiter in the fuel pump prevents overspeeding the engine.

The turbo-diesel meets all 1985 emission standards except those for NO_x, and it doesn't need complicated systems like EGR, air injection, or a catalytic converter. Even so, its NO_x levels are very low—one gram per mile, vs. the 0.4 gpm proposed as standard for the mid-80's.

The exhaust-driven turbocharger, a Garrett AiResearch Industrial Division design, similar to that used on the Oldsmobile V8 diesel, is mounted to the backside of the transverse-mounted engine where it takes up little working space. Its small size makes it unique in the diesel field, where turbos are usually built for giant truck engines.



Turbocharged diesel is similar to engine now in use in Rabbits. Exhaust-driven turbocharger is at right. It cuts in at 1200 rpm. Full boost is at 2000 rpm.

A waste gate that diverts exhaust gases around the turbo when the engine reaches top speed controls the amount of boost the turbine delivers. The turbo is set so that it delivers boost to the engine at very low speeds. The waste gate prevents overcharging with air/fuel at high engine speed, the inevitable result of this design.

A turbocharger acts like a turbine to pack more air/fuel mixture into each combustion chamber. The bigger the charge of air/fuel, the more power punch. You burn more fuel, so you get more power.

Why isn't fuel economy affected? The reason is simple, once you understand fuel-economy tests. The EPA test for economy is run at low engine speeds where the turbocharger does not come into play, so the economy results are the same as if a nonturbocharged engine were being tested. If the engine is used with the turbocharger in operation much of the time, however, fuel economy will drop off.

With the turbo, you can make your own choice between economy and performance. If you want economy, simply run the engine at moderate speeds.

Safety design

The IRVW's safety-built body is just as interesting as the power train. Repeated tests in a variety of crash situations show that you can survive head-on collisions against a fixed barrier—like a reinforced-concrete wall—at speeds up to 40 mph; or you can run into a telephone pole at 30 mph—an extreme test of a car's capacity to protect the occupants—and survive with no serious injury. If the IRVW runs head-on into a bigger car at 60 mph, the passenger compartment remains intact.

The IRVW looks and drives like the production Rabbit. It weighs only 2072 pounds, about 200 pounds more than a '78 model. The IRVW, however, has two fork-shaped steel frames that extend from the front bumper and spread around each front passenger beneath the floor pan. The frames dissipate impact shock and form a protective ring of steel ahead of the passengers.

Passive seat belts, similar to those on the showroom Rabbits, take the place of expensive air bags in this Rabbit of the future. For extra protection, the belts have a tightening device that pulls them snugly to the passengers' chests in an accident, thus leaving no room for the passengers to pitch forward or slide out during impact.

VW officials say that virtually all of IRVW's advanced parts could show up on production Rabbits and other VW's before 1985. In fact, says one company executive, the complete package could be in production in three years.

Best bet for the first item to show up on a car you can drive is the five-speed transmission, which could be in production within a year. PS

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Feed logs to your oil burner?

Multi-fuel furnaces

Furnaces that can burn two or more fuels let you switch in an emergency, may even save you money

By VICTOR D. CHASE

As I began my tour of Wilson Industry's furnace plant, the temperature outside was in the mid-90's. Not the kind of weather to get me excited about heating equipment. Yet, the winter of '76-'77 was still on my mind. Despite the heat, the memory of my fuel bills was chilling. Worse still was the fear created by last winter's natural-gas shortage and the threat of future oil embargoes. What if I woke up one morning and discovered that fuel was temporarily unavailable at any price?

If the booming combination-furnace industry is any indication, I'm not the only one who's worrying. Combination furnaces that burn either gas or oil and a solid fuel (wood, coal, or both) are fairly new to this country. Most units were introduced only about four years ago —yet today manufacturers can't keep up with the demand.

"The first 50 units sold out immediately, and I've already presold 100 from the next shipment," said Peter Landucci, president of Arotek Corp., when we discussed the Hoval combination boiler that he began importing late last year. And John Dickerson, general manager of the Duomatic Division of Manoir International, says: "If you look at our sales figures, you see a vertical line."

Greg Iverson, marketing director of Wilson, which makes the Yukon multi-fuel furnace, comments: "People are buying these units without intending to burn much wood immediately. But the capability is there for their use. It's insurance, in view of what's already happened."

Combination furnaces cost about $800 more than conventional units. Spending that much for emergency backup may not fit your budget unless the furnace can also save you money. In some cases it will.

Huge savings possible

Dean Carpenter lives about 55 miles north of Minneapolis, where winter temperatures can fall to 35 below. He saved on fuel costs last winter by burning six cords of red oak in his Yukon oil/wood furnace. The oil burner, used for backup heat, consumed 300 gallons. At 37 cents a gallon, Carpenter's total fuel costs for the year were $111. The wood was free, he told me. "I cut it myself from a stand of trees that had died of oak disease."

Another homeowner, Jerry Hopkins of Lino Lakes, Minn., just installed a Longwood gas/wood-fired furnace. As we inspected it, he told me why. "My wife just wouldn't stand still for 65 to 68 degrees next winter. We were cold last winter and there's no reason to be."

Hopkins' installation cost $2500, which includes the new chimney he needed to handle the wood-burning. "We figure it will pay for itself in seven years at current rates," he said, adding that he plans to get 75 percent of his heat from wood.

Can you match these savings by switching to a combination furnace? According to David Tjosvold, president of Wilson, it depends on where you live. "Wood costs some people nothing," he said. "Others have to pay up to $80 or $100 a cord. At those prices you're not saving anything now, but that may very well change."

Before you invest in a multi-fuel furnace, there are other things to consider besides fuel savings. Heating a house with wood or coal is a tricky business that creates problems of both safety and efficiency. There are a number of different types of combination furnaces—each designed, according to its maker, to solve these problems. But there's a final problem. Combination furnaces may not even be legal in your area.

Many muncipalities require furnaces to be certified by an approved testing laboratory, such as the American Gas Assn. or Underwriters Laboratories. Since multi-fuel furnaces are relatively new to this country, many labs have neither approved nor disapproved of any combination equipment. One exception: the Canadian Standards Assn., which has set specifications for multi-fuel furnaces. According to Dickerson, both Duomatic and Newmac furnaces meet these standards, which are accepted by a number of U.S. municipalities. But before you look into a multi-fuel furnace, be sure to check your local building code. If such units are permitted in your area, here's what you should know before you decide to buy.

How they work

Multi-fuel furnaces work a lot like conventional ones. In your regular gas or oil hot-air furnace, a

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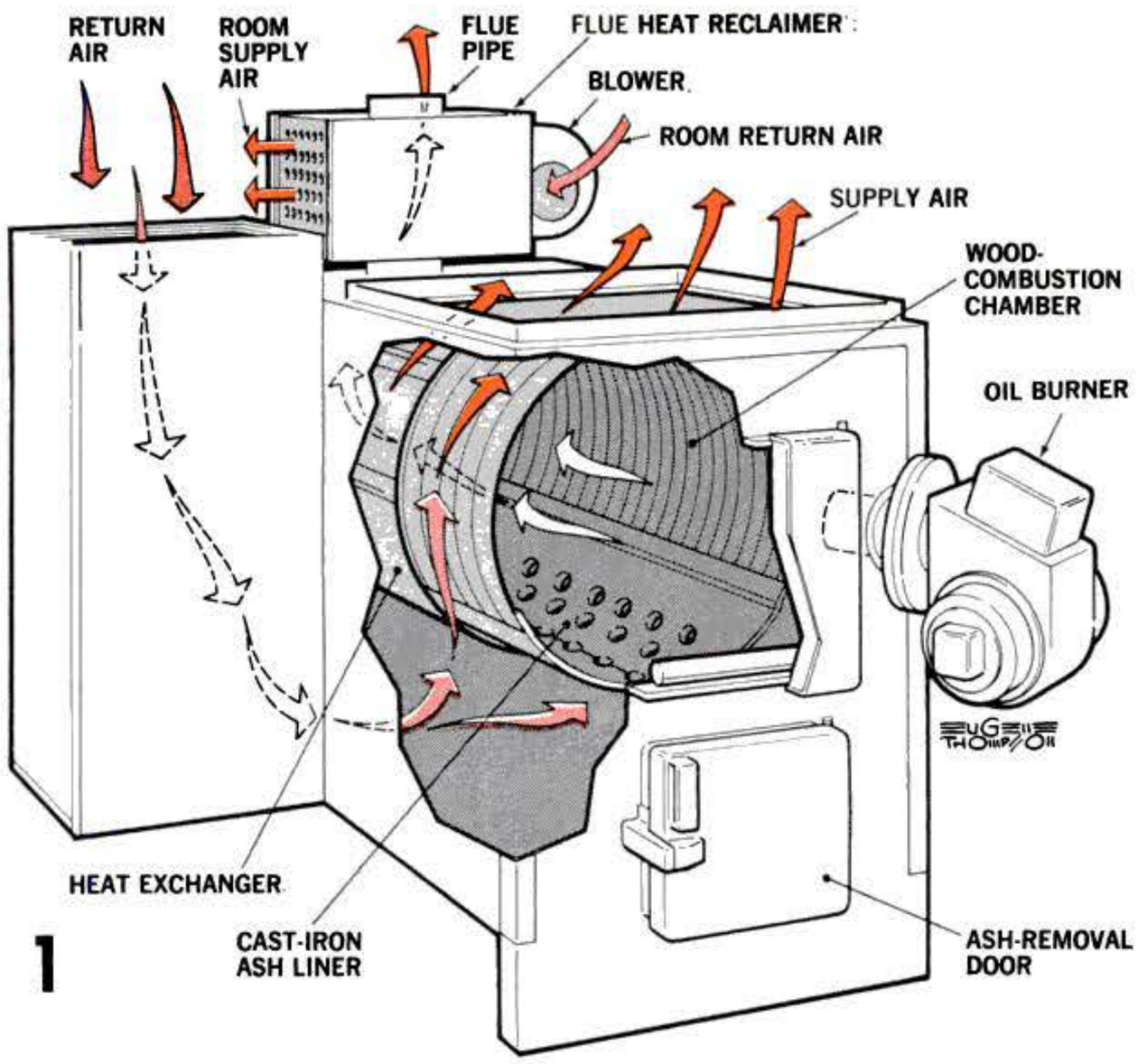
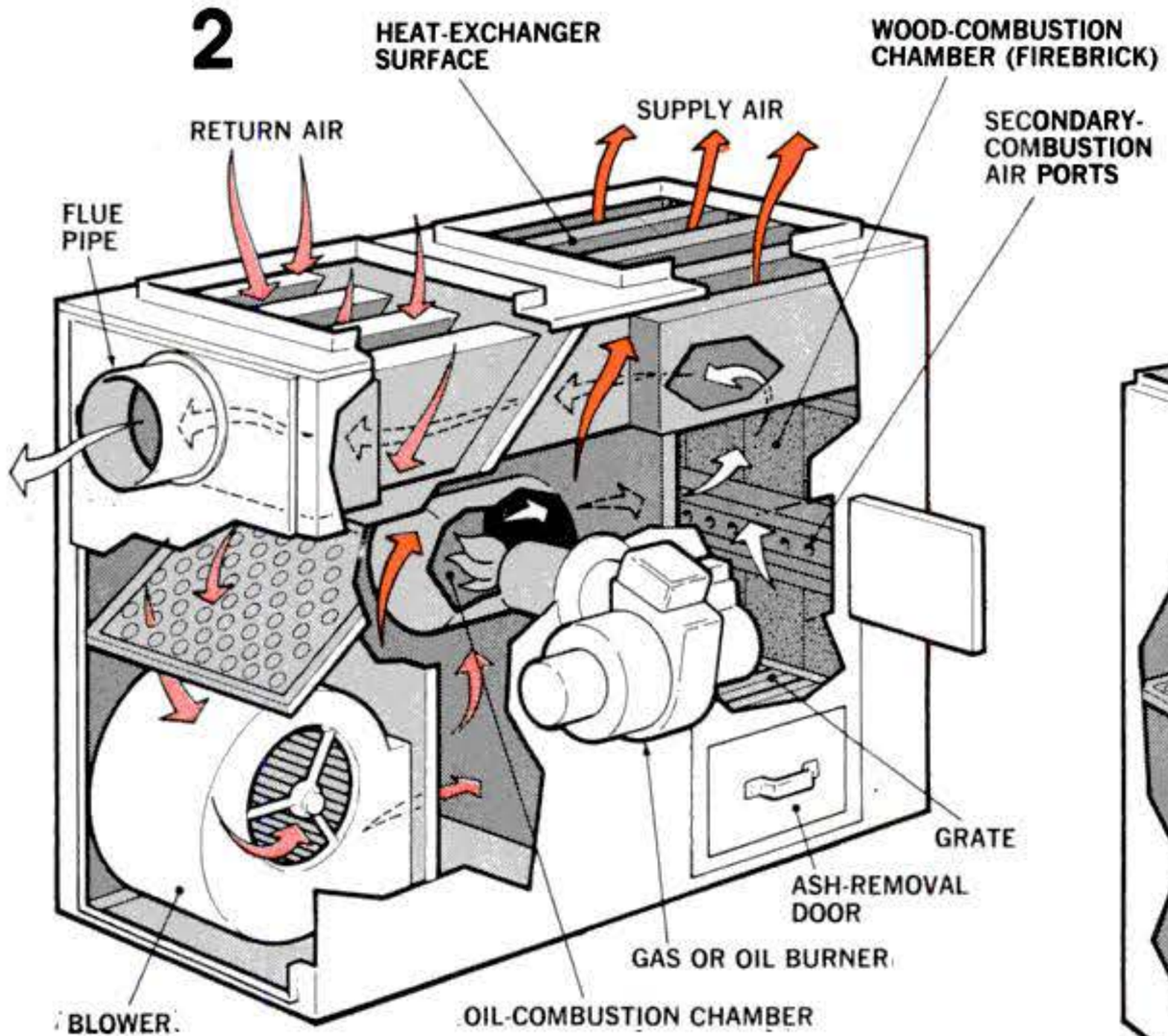


LONGWOOD FURNACE

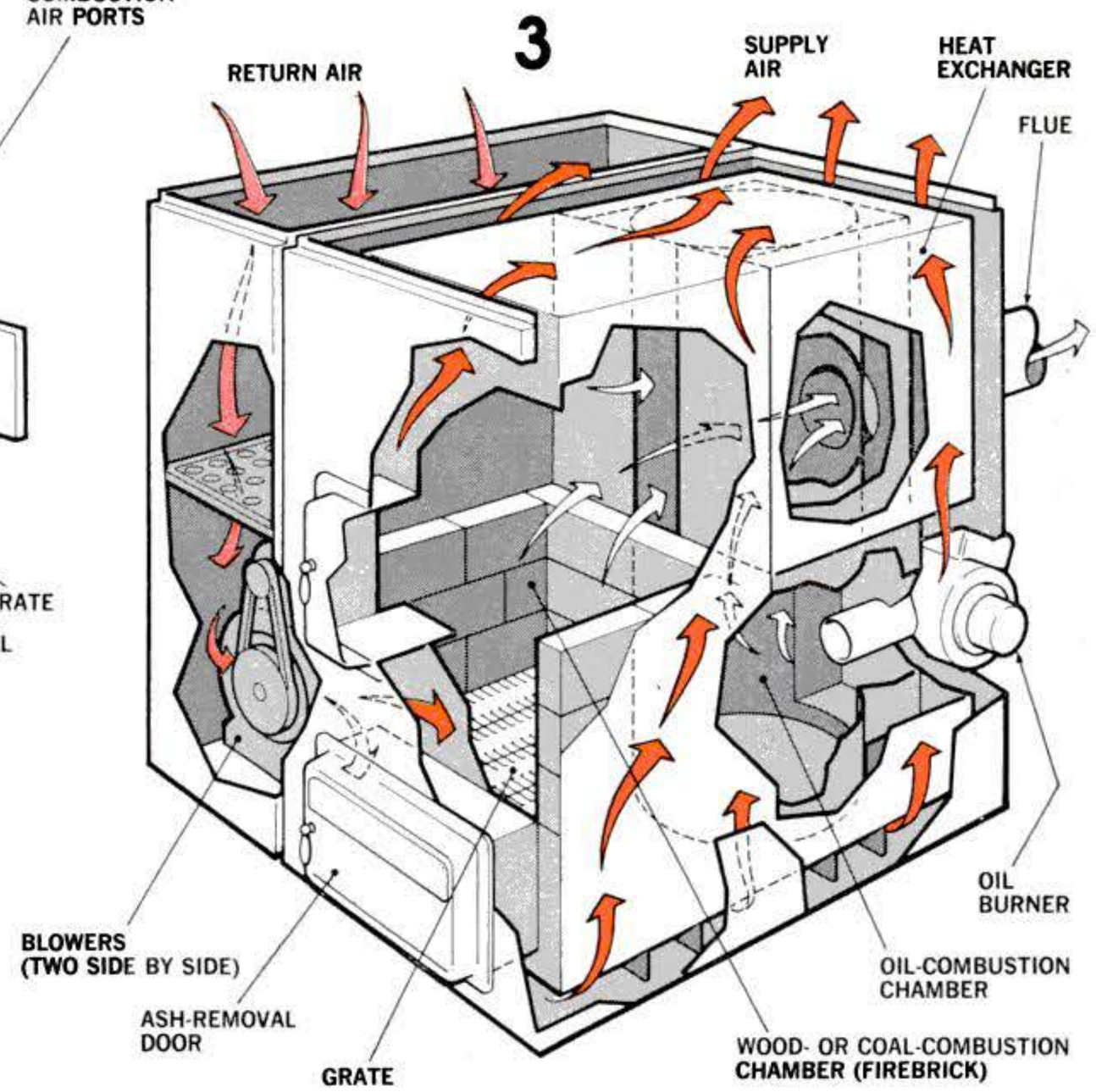
1. Huge combustion chamber in the Longwood Dual Fuel furnace holds a five-foot log that's ignited by an oil or gas burner. Air blown over outside of chamber is ducted through the house. A separate blower forces room air through tubes in flue-heat reclaimer, to capture heat from exhaust gases that pass over the tubes before exiting up flue. Supply air from process warms furnace room.

2. Gas or oil burner on the Yukon furnace has a separate combustion chamber —a cylindrical housing that protects it from wood-combustion products. The gun nozzle is set in from the wood chamber, but fires directly into it. Primary combustion air enters under the grate; secondary air enters over the door, and is preheated as it passes through perforated pipes running along chamber walls.

3. Hot gases from Duomatic's separate combustion chambers circulate inside a single heat exchanger on their way to the fuel. Heat from these gases is captured by return air, which is blown over the entire outer surface of the heat exchanger, then ducted up into the house. The two blowers operate simultaneously for even air distribution.



YUKON FURNACE



DUOMATIC FURNACE

flame from a burner heats air inside a metal box. This box acts as a heat exchanger—when it reaches a certain temperature, a blower forces air over its outside surface. The heated air is ducted throughout the house, while the combustion products inside the heat exchanger are vented up through the chimney.

All multi-fuel furnaces have heat exchangers, all use some kind of burner gun to fire the gas or oil, and all are regulated by a thermostat.

The basic difference, of course, is that combination furnaces burn more than one fuel. Most multi-fuels give you three operating options: They can burn oil or gas alone; they can burn wood or coal alone; or they can burn both at different times, with the conventional burner providing supplemental heat when the solid fuel is consumed. In many cases, the burner gun ignites logs, eliminating hand-kindling.

Most furnaces with automatic solid-fuel ignition have single, two-stage thermostats. Both Yukon and Oneida, for example, have such dual-control thermostats: One stage regulates the wood-firing cycle, the other is set a few degrees lower for

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the gas or oil burner. When the house temperature drops below the lower setting, the burner kicks on, igniting wood in the combustion chamber. The burner shuts down when its thermostat setting is satisfied. The primary air damper for the wood-combustion chamber stays open until the wood setting on the thermostat is satisfied. Then the damper closes, opening again if the temperature falls a degree or so. When the wood burns out (about three or four times a day during the coldest periods), the temperature drops to the lower setting and the oil burner comes on again. At this point, you can add more wood to the combustion chamber.

Furnaces in which the solid fuel must be hand-kindled, such as the Newmac and Duomatic, usually have two separate thermostats, but the operating principle is the same.

Sound simple? Basic operation is, but solid-fuel combustion creates some problems. Take coal, for example.

The heating potential of wood— and fossil-fuel equivalents

You can use these figures to calculate whether a multi-fuel furnace will save you money. The first column shows the number of potential Btu in a cord of wood. (All wood with a 20-percent moisture content has a heating potential of about 7000 Btu per pound. Since a cord of wood is 4'-by-4'-by-8', the heavier the wood type, the more Btu per cord.) The next three columns show how much fossil fuel you'd need to equal the heating potential of wood. To find out whether you could cut your oil bills by burning wood, first get the price for a cord, then multiply the price you pay for a gallon of fuel oil times the number of gallons you'd need to equal the Btu in a cord. If white oak, for example, costs $50 a cord, and oil costs you 50¢ a gallon, then you'd pay $110 for the quantity of oil needed to give the Btu in $50 worth of wood. You can also use the table to do the same type of calculations for coal, if it's available in your area.

Wood type	Btu (in millions) per air-dried cord (20% moisture)	Equivalent coal (tons anthracite)	Equivalent natural gas (cubic feet)	Equivalent #2 fuel oil (gallons)
White oak	30.8	1.26	30,800	220
Sugar maple	29.7	1.18	29,700	212
Red oak	27.3	1.14	27,300	195
White ash	25.9	1.10	25,900	185
American elm	23.8	0.93	23,800	170
Red maple	23.8	0.93	23,800	170
Birch	23.8	0.93	23,800	170
Douglas fir	21.4	0.77	21,400	153
Aspen	17.5	0.69	17,500	125
White pine	15.8	0.67	15,800	113

Buyer's guide to combination home-heating equipment

Model and maker[1]		Types of fuel burned[2]	Mfgr.'s suggested retail price[3]	Combustion facts[4]
Charmaster (F)	Charmaster Products, Inc., 2307 Hwy. No. 2 West, Grand Rapids MN 55744	W & O	$1340-$1890	One CC; AI
Combo (F & B)	Combo Furnace Co., Div. of Northern Htg. & Sheet Metal, 1707 W. 4th St., Grand Rapids MN 55744	W & O	(F) $1300-$1450 (B) $1595	Two CC; AI Two CC; AI
Duo-Matic (F)	Manoir International, Inc., 2413 Bond St., Park Forest South IL 60466	W & O W/C & O	$1300-$1400 $1756-$1811	Two CC; HK Two CC; HK
Hoval (B/DWH)	Arotek Corp., 1703 East Main St., Torrington CT 06790	W/C & G/O	$1700-$2950	Two CC; HK
H. S. Tarm (B/DWH)	Integrated Thermal Systems, 379 State St., Portsmouth NH 03801	W & G/O/E	$1505-$2120	Two CC; HK
Logwood (F & B/DWH)	Marathon Heater Co., Box 265 R.D. 2, Marathon NY 13803	W & O	(F) $1914-$2513 (B) $3000	One CC; AI One CC; AI
Longwood (F)	Longwood Furnace Corp., Gallatin MO 64640	W & G	$1600-$1800	One CC; AI; fossil-fuel burner must be operating for significant wood combustion to take place.
Newmac (F)	Dual Fuel Products, Inc., Box 514, Simcoe, Ont., Canada	W & O	$1475-$1675	Two CC; HK
Oneida (F)	Oneida Heater Co., Inc., P.O. Box 148, Oneida NY 13421	W & G/O W/C & G/O	$2295-$2510 $2099-$2953	One CC; AI One CC; AI
Riteway (F & B/DWH)	Riteway Mfg. Co., P.O. Box 6, Harrisonburg VA 22801	W/C & G/O	(F) $1442-$2760 (B) $2400-$3840	One CC; AI One CC; AI
Yukon (F)	Wilson Industries, Inc., 2296 Wycliff St., St. Paul MN 55114	W & G/O	$1400	Two CC; AI

[1]F—furnace; B—boiler; B/DWH—boiler with domestic water heater
[2]W—wood; C—coal; O—oil; G—gas; E—electricity
[3]Price ranges cover a number of models in same line; prices can vary widely, depending on region and contractor
[4]CC—combustion chamber; AI—automatic ignition of solid fuel; HK—hand-kindling of solid fuel

Fire coal carefully

Coal-burning furnaces must accept many types of coal, each with its own burning characteristics. But all coal types have one thing in common—they generate more Btu per pound than wood. That means they burn hotter, and a furnace must be capable of handling that heat.

And coal combustion in multi-fuel furnaces could be dangerous. If a flame from a gas or oil burner is directed at coal that's too tightly packed, excess, potentially explosive gases can be generated. To guard against this danger, coal should be hand-kindled.

Most manufacturers of combustion coal-burning equipment make sure the burner gun can't ignite the coal—the furnaces have completely separate combustion chambers that isolate coal from the burner. One exception: The Oneida combination furnace has only one combustion chamber, but the manufacturer provides for—and strongly recommends—closing off the burner-gun access when coal is being used.

The creosote danger

Wood combustion presents another set of problems. Wood is an extremely complex organic compound. As it burns, it first releases water; next, it breaks down into charcoal, volatile gases, and liquids. Finally, the charcoal burns, producing most of the heat. The volatiles can also generate heat, but if unburned, they can lead to creosote buildup.

Creosote, an acidic byproduct of wood combustion, combines with the moisture in the burning wood. When the wood is dry enough, and the fire hot enough, much of the creosote is either burned or escapes up the chimney. In a cool chimney, however, the creosote-containing vapor condenses and trickles back down toward the furnace, where the water vapor evaporates. You're left with a solid residue of sticky creosote. When ignited, solid creosote makes an extremely hot fire.

Three things prevent excess creosote buildup: high chimney temperatures, dry wood, and efficient combustion. The temperature at the top of the chimney should never fall below 212° F, the vaporization point of water. This is a minimum —for additional safety, many furnaces keep chimney temperatures as high as 500°-600°. So, if you install a multi-fuel furnace, you may need a new chimney. You should have a Class A, all-fuel-type chimney made either of stainless steel or tile-lined brick. (If you have an oil

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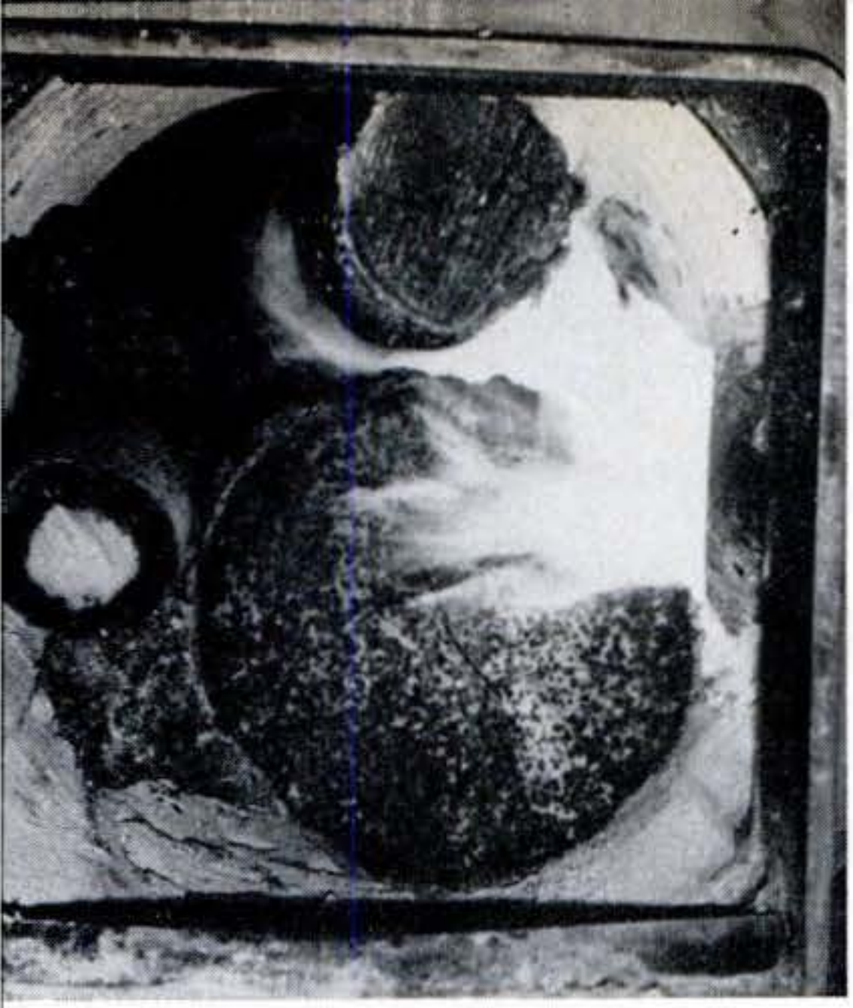

Flames from gun burner at the right of the Longwood combustion chamber shoot in, igniting logs. The burner also flames gases rising from burning wood.

CO_2 levels and gas temperatures in a flue pipe are measured by David Tjosvold of Wilson Industries to determine operating efficiency of Yukon furnace.

furnace, you already have a Class A chimney.)

All manufacturers agree that burning dry wood (less than 20-percent moisture content) will also prevent creosote buildup. But they differ on how to achieve efficient combustion—the third key factor. Contrasting theories are reflected in the designs of multi-fuel furnaces, which differ mainly in the number of combustion chambers and how combustion air is provided.

Both Longwood and Oneida, for example, make furnaces with one combustion chamber—but each introduces its combustion air differently. In the Longwood units, a limited amount of combustion air enters through the gas or oil burner, which, like all gun burners, mixes air with the fuel before firing it. The gun burner fires directly onto the wood. This intense heat, and the small amount of combustion air present, combine to convert the wood into charcoal. The burner continues firing until the thermostat shuts it off. Since this cuts off the combustion air, the wood, instead of burning with a flame, remains as glowing charcoal, which cools down slowly.

This no-draft design, says Longwood, lets the fire burn more slowly and makes the wood last longer. Longwood even extracts Btu from the exhaust gases by routing them through a flue-heat reclaimer (see diagram).

Although Oneida multi-fuel furnaces also fire the gun burner directly into one heat exchanger, the burner has a protective stainless-steel guard that prevents ash or creosote buildup on its nozzle. And Oneida provides more combustion air, following the theory that both primary and secondary air is needed for efficient wood combustion.

Oneida furnaces have both a primary air damper and a secondary air opening in the fire door. According to Oneida's Elbert Niles: "Secondary air is ducted up between the fire door and the furnace liner, so the air is preheated before it's introduced over the fire."

Another furnace that uses both primary and secondary air is the Yukon. It has two combustion chambers (see diagram) to protect the burner from creosote buildup.

As for combustion air, Wilson's David Tjosvold says: "Forty percent of the energy available in wood leaves the top of the flame in the form of unburned gases. In order to burn those gases, you have to introduce air at the top of the flame. The hotter the air, the more gases you'll ignite. The idea is to superheat the air, then introduce it over the flame."

"How do you do that?" I asked. To show me, Tjosvold opened the door of an operating test furnace and pointed to an opening above the door. "Room air enters here," he said, "and is ducted into these tubes." I peered inside and saw perforated pipes running around three sides of the chamber. These hot pipes superheat the air as it passes through them and out the small holes. The flames leaping about these supply holes convinced me of the effectiveness of secondary air.

Separate chambers

One final multi-fuel design features completely separate combustion chambers. Such units as the Hoval and Duomatic are often designed to burn coal as well as wood. But some furnaces that handle only wood, such as the Newmac, also have separate chambers. In these furnaces, solid fuel must always be hand-kindled. But makers of such units say two chambers provide the best protection against the clogging of oil burners by combustion products.

Wood-burning units with two combustion chambers have primary air dampers. According to Dickerson, all of these units also provide secondary air, both through ports in the oil burner, and through a secondary-air draft control that ducts air up around the firebox liner and in over the wood flame.

No matter what the combustion process, all these furnaces use a great deal of air. A wood furnace that burns 278 pounds of wood in 24 hours needs more than 25,000 cubic feet of air. Some of today's tightly built well-insulated homes may not have enough natural air infiltration to satisfy this demand. So, if you install a multi-fuel furnace, be sure there's enough combustion air—even if you have to vent it in from outside.

But are they efficient?

When I asked Tjosvold this final question, he led me to the flue of the test furnace. There we ran a test that showed that the furnace was running nine percent CO_2 at about 300° F. A conversion chart showed us we were getting 80-percent efficiency.

"But what about the oil burner?" I asked. "With the secondary air opening admitting air while the oil burner fires, isn't some efficiency lost?"

Tjosvold agreed but quickly added, "We have so much heat-exchanger surface (63 square feet) that at 78-percent efficiency we're still about eight percent above most standard oil furnaces."

Most manufacturers claim similar efficiencies for their multi-fuel units. But remember that combustion efficiency is not the same as convenience. Add a multi-fuel furnace and you add time-consuming chores—gathering and storing large quantities of wood or coal; loading the firebox three or four times daily; cleaning out ashes—chores you don't have to face with a "set-it-and-forget-it" oil or gas furnace. But the fuel savings you may gain, as well as freedom from worry over shortages and high prices, could make all this labor worth it. PS

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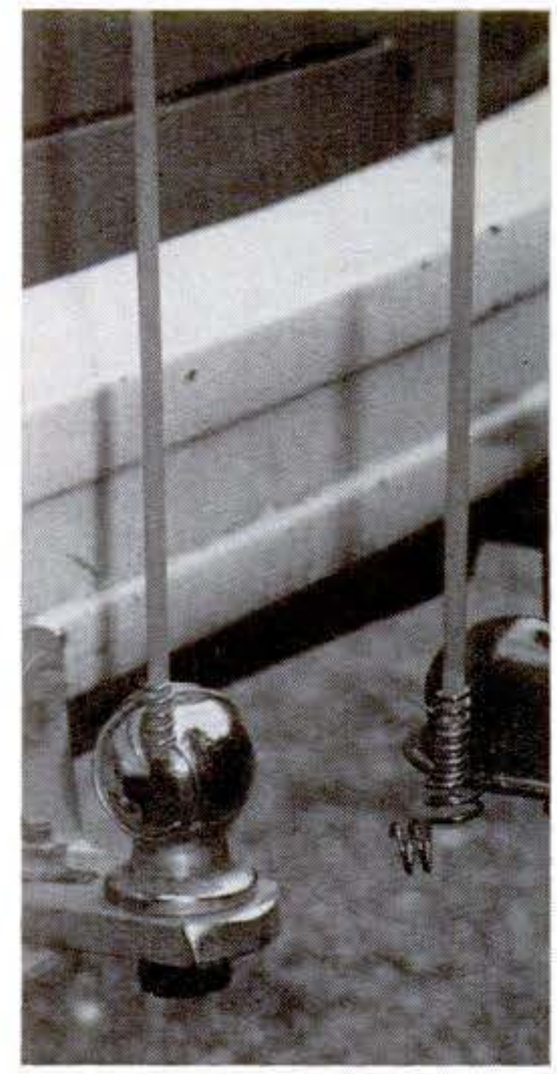
What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS

Fuel stretcher: L-100-50 Hercules

Lockheed's proposed L-100-50 high-capacity Hercules air-freighter would provide 20 to 30 percent fuel savings over similar freighters being planned, says the company. The prop-jet-powered aircraft, shown in an artist's concept, would be 20 feet longer than the present L-100-30 Super Hercules. The stretched-out Hercules will have an 85-foot cargo compartment and carry a 60,000-pound payload 1440 miles. Lockheed-Georgia experts say the L-100-50's low fuel consumption per ton-mile won't be topped for 10 to 15 years.

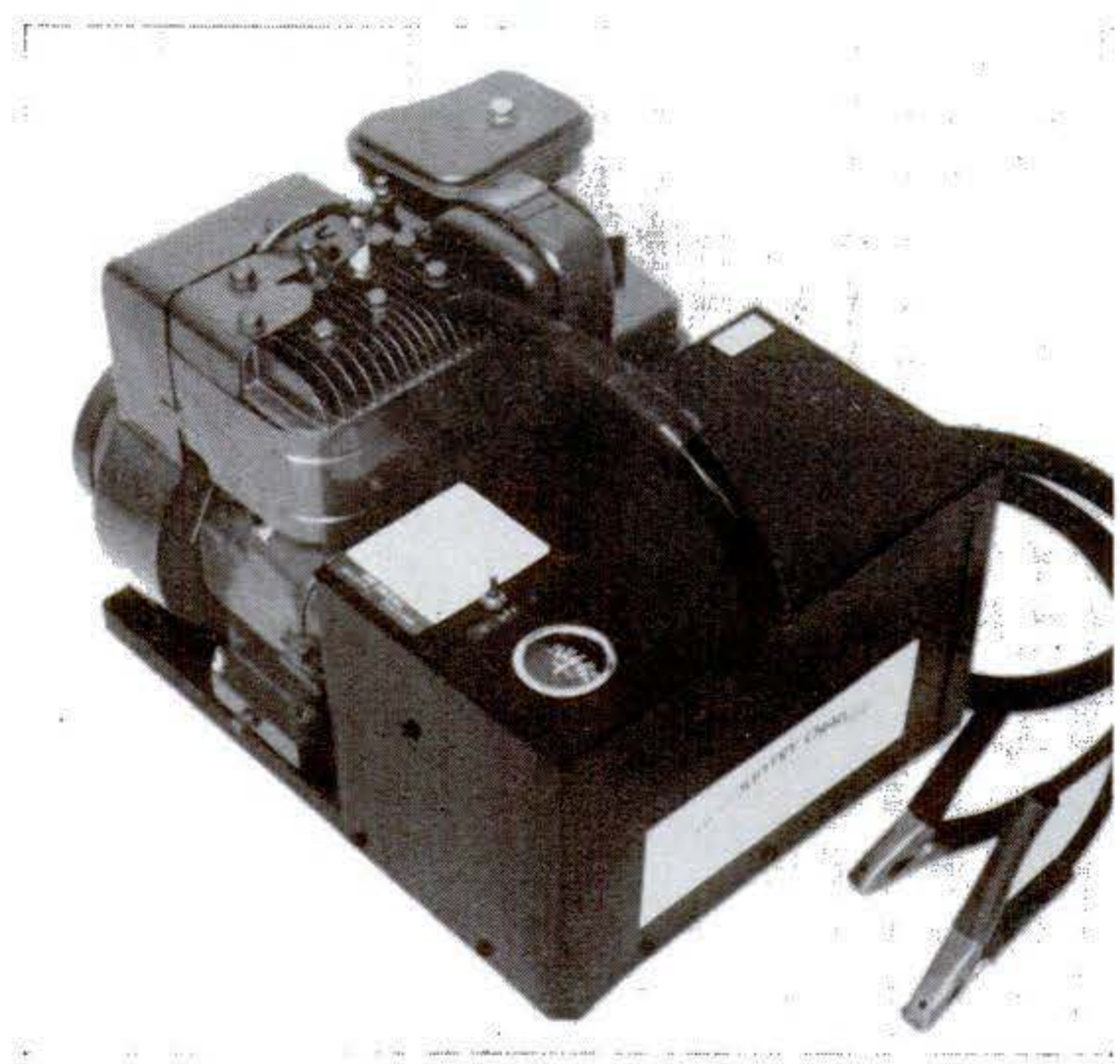


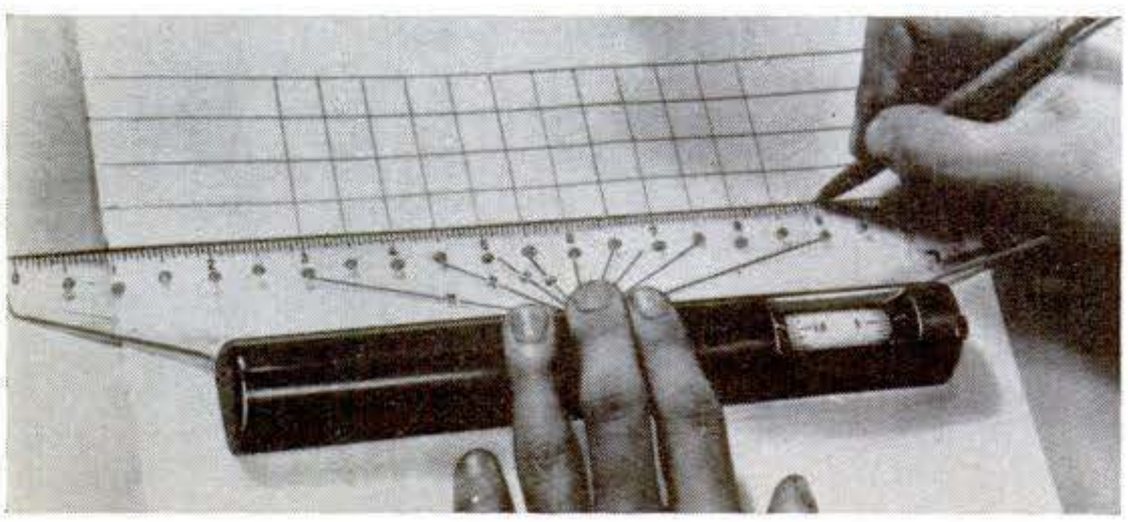
Hitch guides

Bright orange masts simplify aligning tow vehicles and trailers for easy hitching. Snap one to the tow ball, the other to your trailer tongue. Then back up until the masts almost touch. See E-Z guides are $6.95. Made by St. Croix, Park Falls, Wis. 54552.

Air pump

Plug in the Inflator and you can quickly fill rafts, boats, and beach toys with air. The 12-volt air pump inflates to 1.25 psi, so it won't ruin products. Reverse a hose to deflate items. $19.95. Hi-Tech, Inc., 3204 16th St., Zion, Ill. 60099.





Draft aid

This three-in-one drawing and draft instrument (ruler, T-square, triangle) helps space horizontal, vertical, and angular lines. The Rol-Ruler Speedliner 2 is calibrated in 10ths and 16ths of an inch. $5.75. Rockbottom Co., Box 860, D.T. Sta., Canton, Ohio 44701.

Portable charger

Rev up a five-hp gas engine and charge RV batteries or supply 12 volts DC anywhere. The Hi Country Charger has a 60-amp, 12-volt alternator with regulated or high (unregulated) charging. $295. Rocky Mountain Sales & Service, 550 E. 64 Ave., Denver, Colo. 80229.

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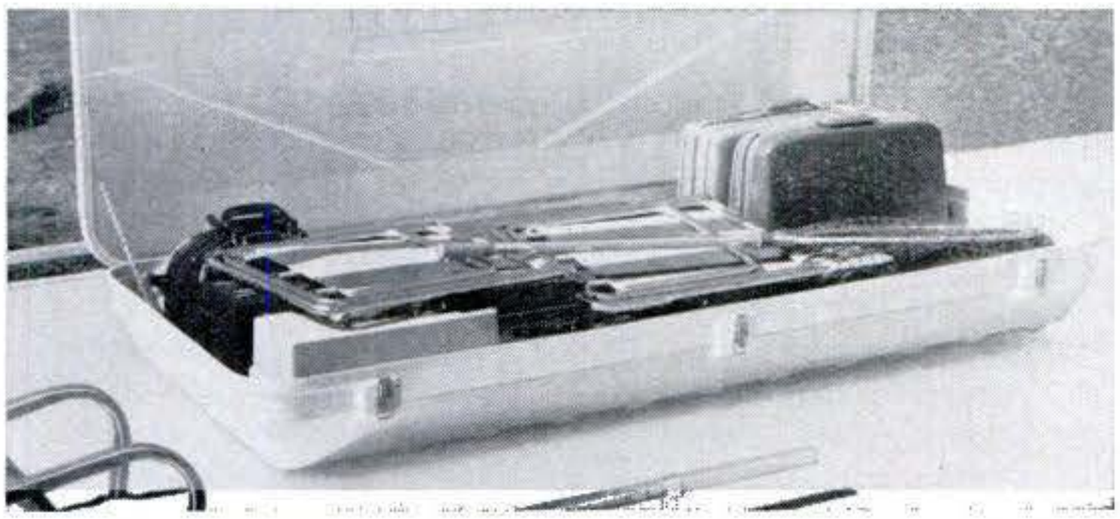
Portable radio for satellite relay

There's no waiting on transatlantic calls with the U.S. Army's new AN/PSC-1 radios. The portable 35-watt transceivers have detachable helical antennas to relay messages through geostationary satellites. Messages are beamed up to satellites and back to earth as digitalized signals (225 to 400 MHz). Suitable for long-range patrols, the backpack radios can also transmit encoded messages (up to 500 characters) in short bursts to avoid detection. The 30-lb. radio sets have whip antennas for local use. Cincinnati Electronics makes the sets for the Army's Satellite Communications Agency.

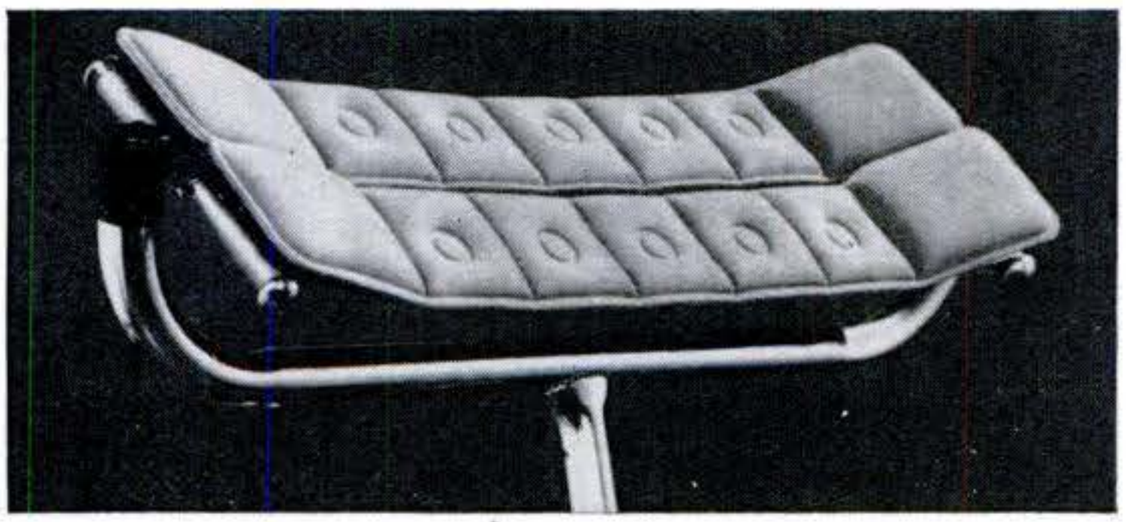


Cargo pod

Need more RV storage space? Attach the C22 E-Z Carrier to your RV or van roof for an extra 24 cubic feet. The streamlined plastic pod has chrome latches that lock. The C14 pod provides 15 cubic feet. Hellstar Corp., 1600 N. Chestnut, Wahoo, Neb. 68066.

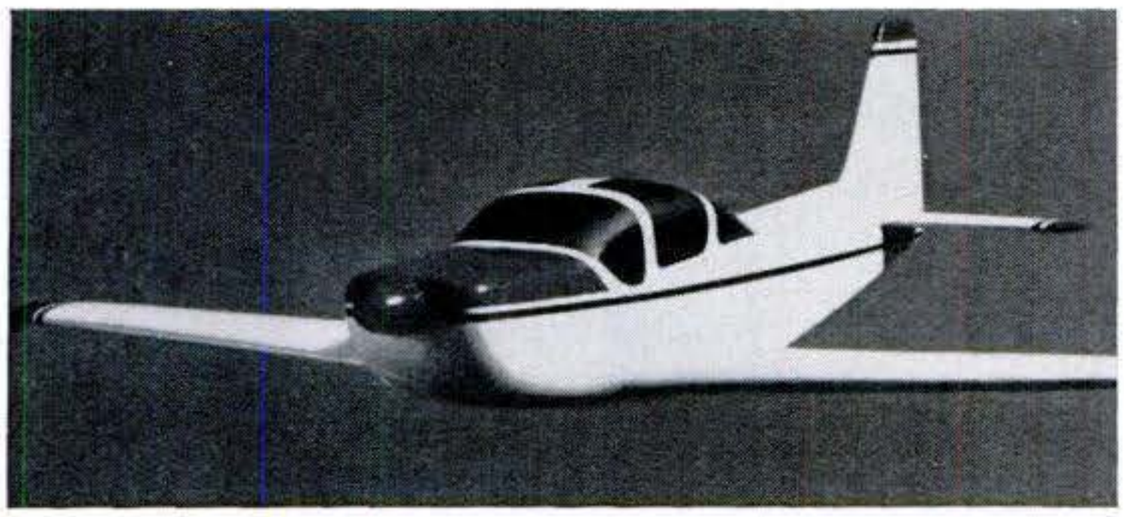
Carton caddy

Take one 68-inch length of five-gauge wire, bend 22 right angles, butt-weld the ends, and you've got a caddy for milk/fruit-juice cartons. The idea won student John Jeffrey Norton the grand prize in the American Iron and Steel Institute's wire design competition.



Bike seat

Cyclists with sore bottoms will find comfort in the Bummer, says the maker. The unique bicycle seat supports the rider's entire backside, flexing and pivoting with leg and hip movements. HMC Products Co., 56849 Grand River, New Hudson, Mich. 48165.



Plane kit

Lots of speed and range—that's the Sequoia design idea. A two-place Sequoia with a 325-hp turbocharge engine should cruise at 264 mph at 18,000 feet. Sequoia Aircraft Corp., Richmond, Va., is selling kits to pilots who can test their own hand-built planes.

Binocular camera

Turn the focusing ring on the Orinox AA1-720 to adjust its 7 X 20mm binoculars—and the 112mm f/5.6 lens on its 110-cartridge camera. Diaphragm and shutter are set manually. Asia American Industries, Kyodo Ginza Bldg., 18-6 1-chome Ginza, Chuo-ku, Tokyo, Japan.

Dry sack

Stay warm and dry at outdoor stadium events in an insulated sack that zips up to your chest. Heritage Quilts' Game Bag is insulated with Dacron polyester and has water-repellent, machine-washable fabrics. It's $20 in stores.

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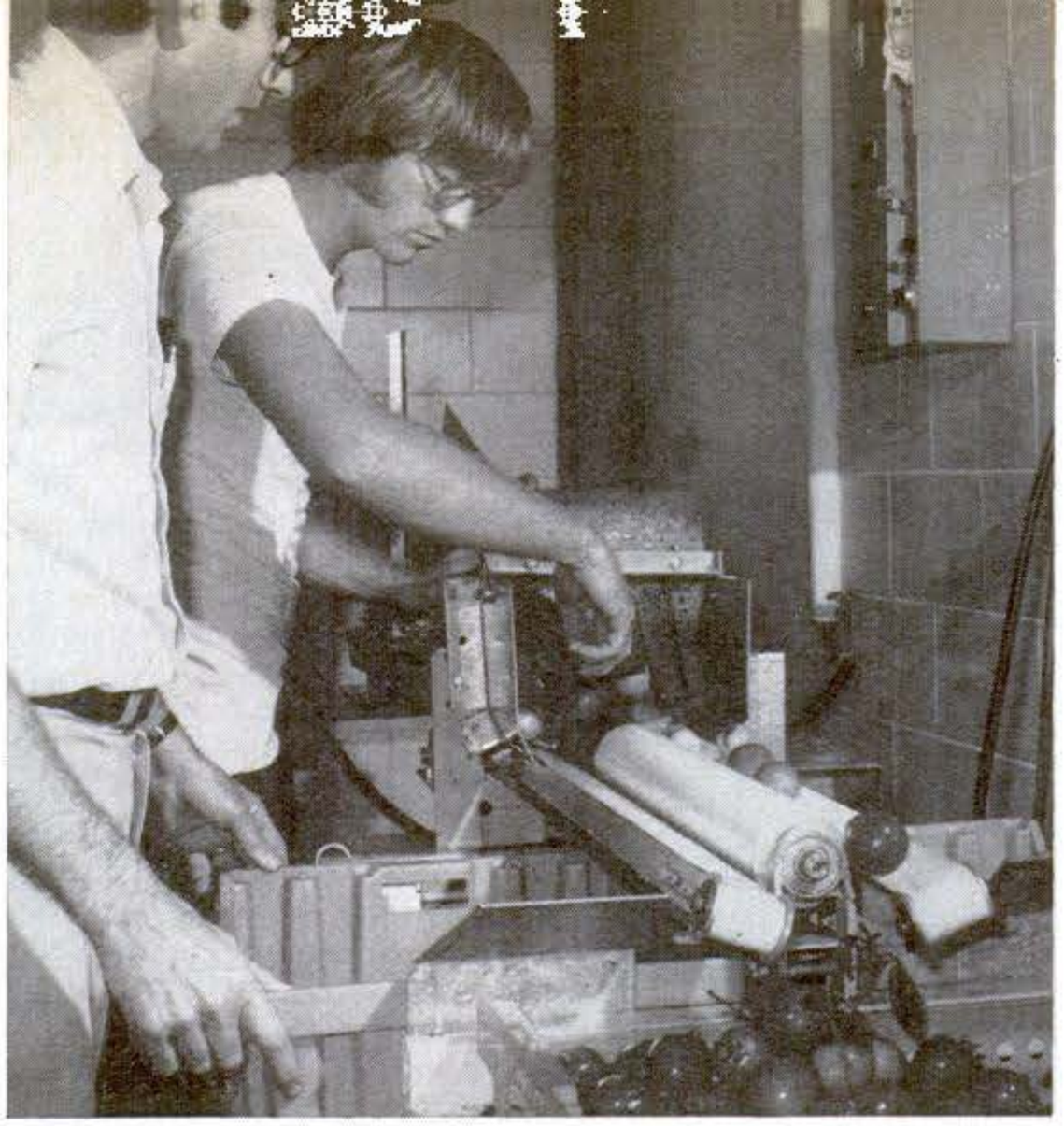
What's New

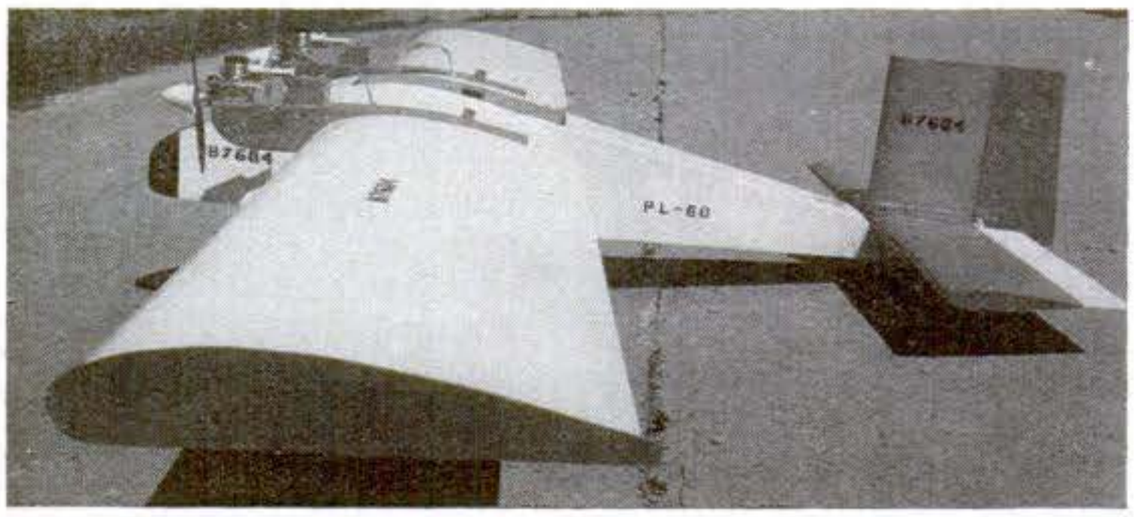


Tomato sorter

Pour ripe and green tomatoes into this machine—over 20 tons per hour—and it separates them. Firm green tomatoes bounce from a vibrating pipe; soft ripe tomatoes absorb the impact and pass along two belts. Ohio State professor Robert Holmes developed it.

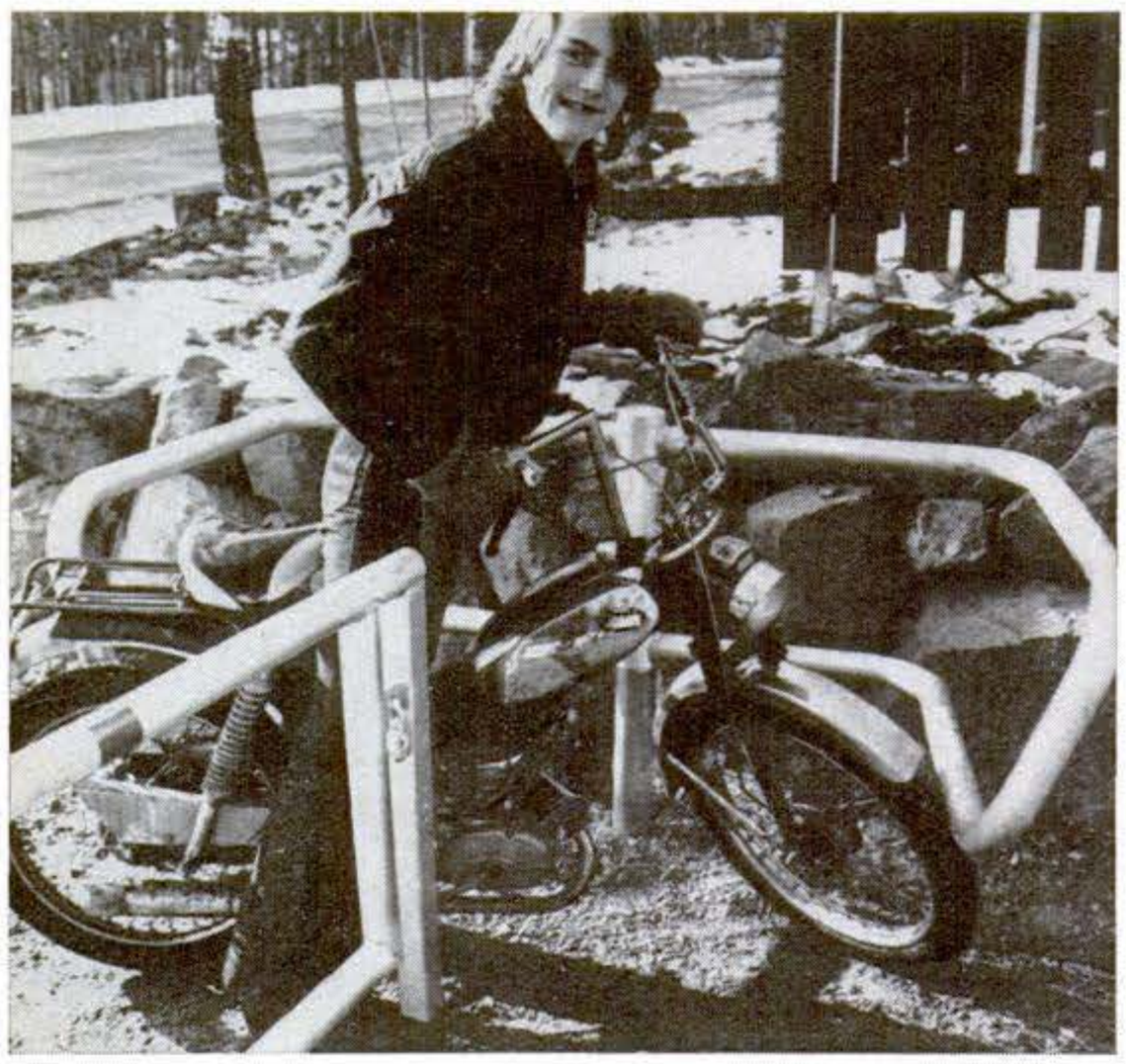
Trailer lock

Discourage trailer thieves by attaching the coupler to the Hitchin Post's substitute hitch ball. A steel chain secures couplers to the portable stand, and a key-activated siren sounds if tampering occurs. $89.95. Gilco, 3715 Minnehaha Ave., Minneapolis, Minn. 55406.



Twin-prop RPV

Twin 1.9-hp engines power the PL-60 RPV (remotely piloted vehicle) over 35 miles at 65 mph. The 60-lb. RPV has a 130-inch wingspan. Mid-Continent Scientific, Des Plaines, Ill., makes the $10,000 plane for border and traffic surveillance, and photography.

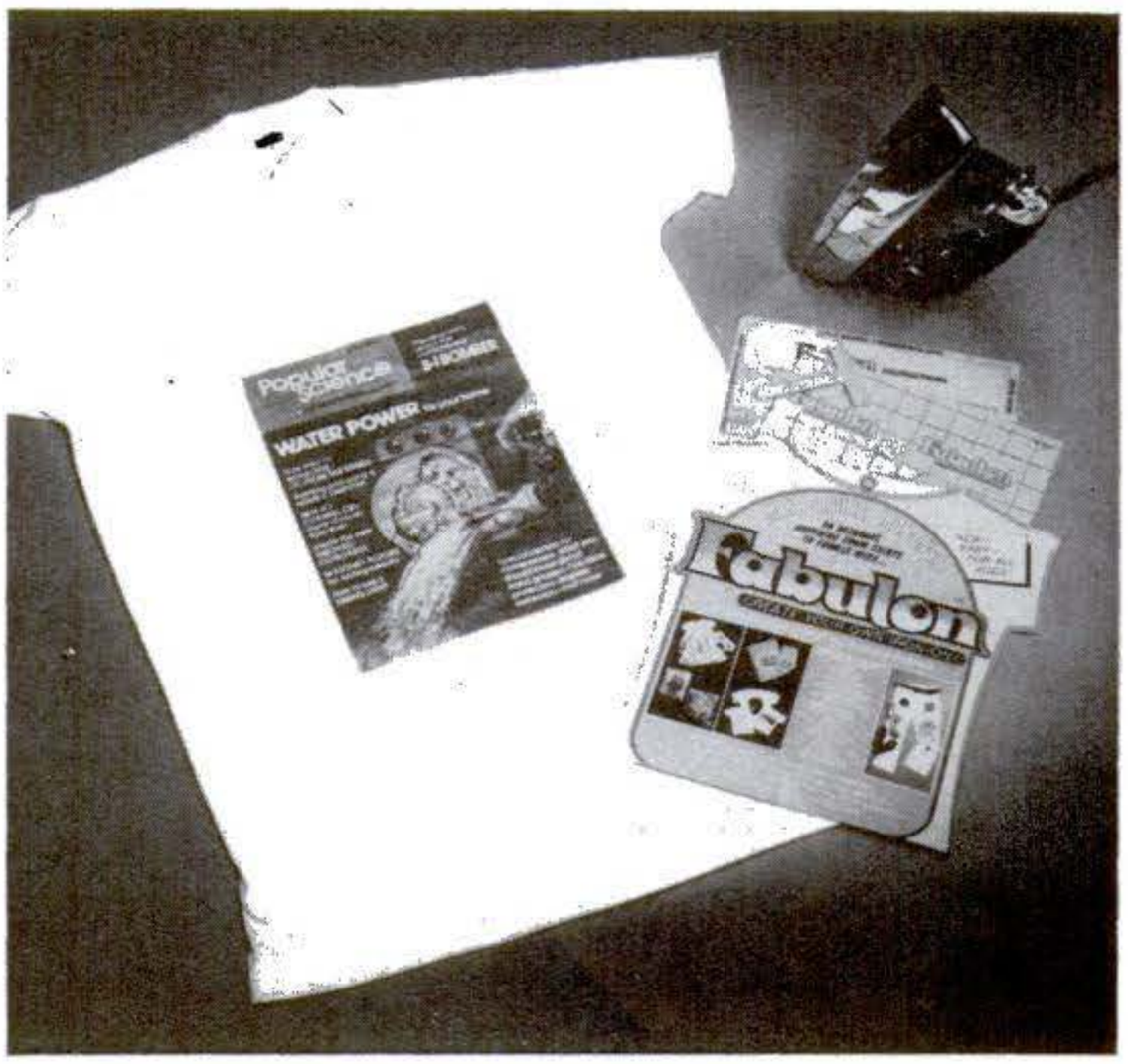


Bike stop

A swivelling barrier keeps unwanted bikes from footpaths, but passes short-wheelbase carriages, strollers, or wheelchairs. A U-shaped tubular frame turns in an upright post when you walk through. Granges Aluminum Montal, Boc 60110, S-791 07 Falun 7, Sweden.

Sun meter

Experimenting with solar power? The SM-12 Solar Energy Meter shows percentage of full sunlight to help check collectors, concentrators, glazing materials. A silicon sensor powers the meter. $44.50. Cushing Instruments, 455 Retaheim Way, La Jolla, Calif. 92037.



Iron-on transfers

Press Fabulon sheets on printed images and the pictures can be ironed onto fabrics. Sheets are soaked in warm water to remove paper—pictures stick on the sheets. The transfer images are machine washable. Sangray Corp., 2318 Lakeview Ave., Pueblo, Colo. 81004.

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What's New IN BOATING

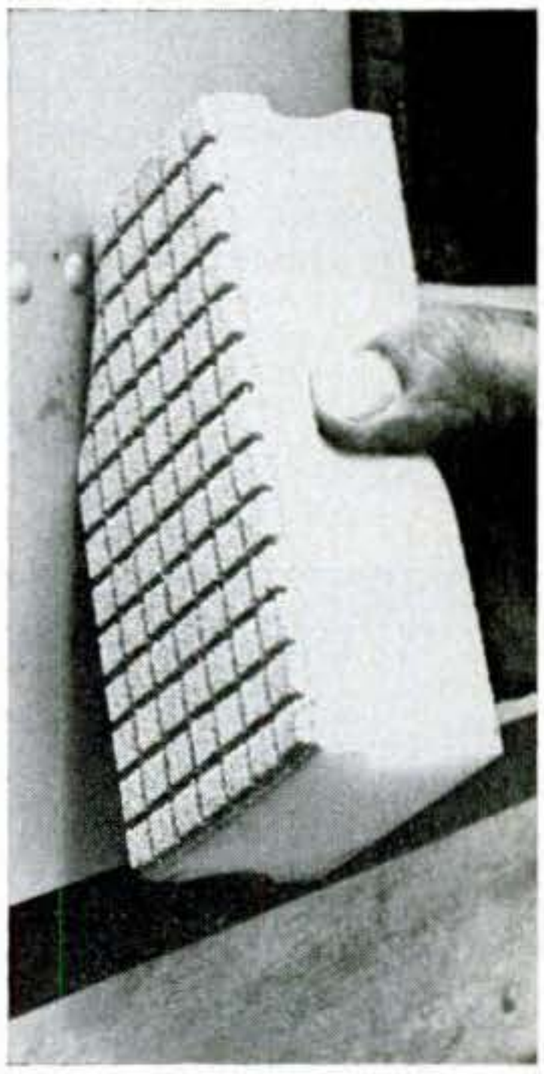
BY SUSAN RENNER-SMITH

Water scooter

Like a seagoing motorcycle, the Water-Bronco has twist-action shift and throttle controls on the handlebar. A 20-hp (or less) outboard powers the 10′ 10″ fiberglass craft. Two can ride it—but it's SRO. Price: $895 from Peterson Boats, Box 7405, Chicago, Ill. 60680.

Bunk bedding

Tuck the kids in fast with this combination top sheet, bottom sheet, and pillow pocket. Elastic straps hold it to the bunk. Providence House (1539 Monrovia Ave., Newport Beach, Calif. 92663) makes the 'Snoozer' in six prints and two solids. Price: $20.



Scouring sponge

Matey's built-in abrasive grid scours your boat without scratching, says Avmetco Corp. (14 Wilton Rd. W., Ridgefield, Ct 06877). The flexible urethane-foam sponge has side grooves for easy gripping. Reverse the sponge for sudsing and rinsing. Price: $2.25, ppd.

Front rower

You can watch where you go as you row—with His Nibs Front Row. Stainless-steel cables reverse the rowing action. Oars fold back flat for storage. With oars, the device is $150; without, $120. Nibs White, 1104 S. Bay Front, Balboa Island, Calif. 92662.

Automatic tiller

Let the Seacourse autopilot take the helm and it'll keep on course, while adjusting smoothly to wind and sea. Three sensitive controls prevent abrupt overcorrections, says the maker (Epsco/Brocks, 411 Providence Hwy., Westwood, Mass. 02090). Price: $595.

Master sentry

Got smoke, burglar, *and* flood detectors on board? You can wire them all to the Marker 7 Boat Guard. The battery-powered master alarm sounds a loud, wailing siren if a sensor is triggered. Price: $150. GGT Dist., 3410 Enterprise Ave., Naples, Fla. 33942.

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What's New IN TOOLS

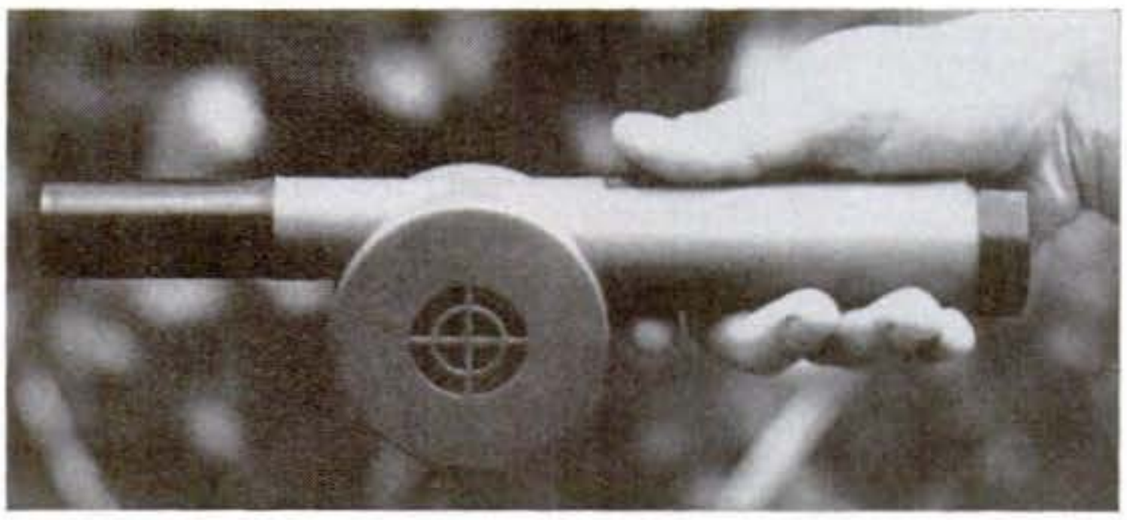
BY R. L. STEPLER

Tumbler

It deburrs, descales, degreases, burnishes, cleans, and polishes a wide variety of metal parts. That's the claim for the Mobile Tumble Bench from Distributor Sales (Box 363, Woodstock, Ill. 60098). Model 914 has ¾-cu.-ft. capacity, costs $1195; model 2016 holds 2.6 cu. ft. Price: $2195.

Log splitter

Honest Abe never had it so good: A hydraulic jack in the Abe Lincoln log splitter makes the task child's play, according to its maker. Two models split 19" and 26" logs, sell for $150 and $155, respectively. Better-Way Products, 21330 Center Ridge Rd., Rocky River, Ohio 44116.



Blower

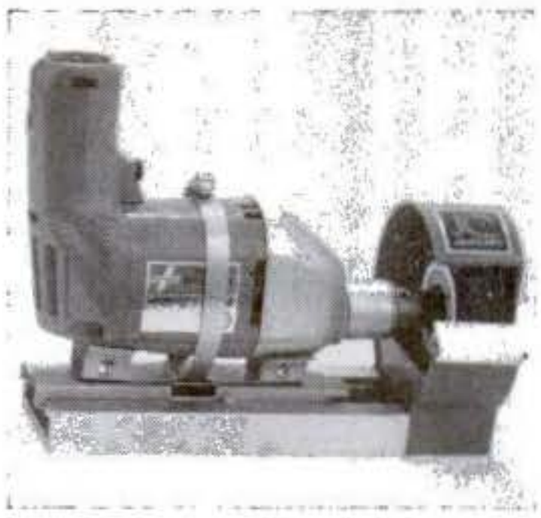
You'll kindle wood fires faster and start charcoal barbecues more easily with this hand-held, battery-powered mini-blower, says Spectra International (Box 534, Norwood, Colo. 81423). The blower's price is $9.98.

Branding iron

Proud of your wood or leather projects? Put your name on 'em with the Maker's Mark branding iron. The 125-watt tool is priced $21.45. From Craftmark Products, Inc., Box 6308, Marietta, Ga. 30065.

Grinder plus

Readi-Grinder sands, polishes, wire-brushes, hones, and grinds. Your portable electric drill provides the power. It comes with a coolant tray and an angle guide. Price: $17. Maker: Jimkraft Corp., Box 2004, Saginaw, Mich. 48605.



Respirator

An activated-charcoal filter in 3M's new spray-paint respirator protects you from asbestos particles and from vapors from urethanes, lacquers, and paints containing isocyanate hardeners. Model 06984 weighs two oz. 3M, Box 33686, St. Paul, Minn. 55133.

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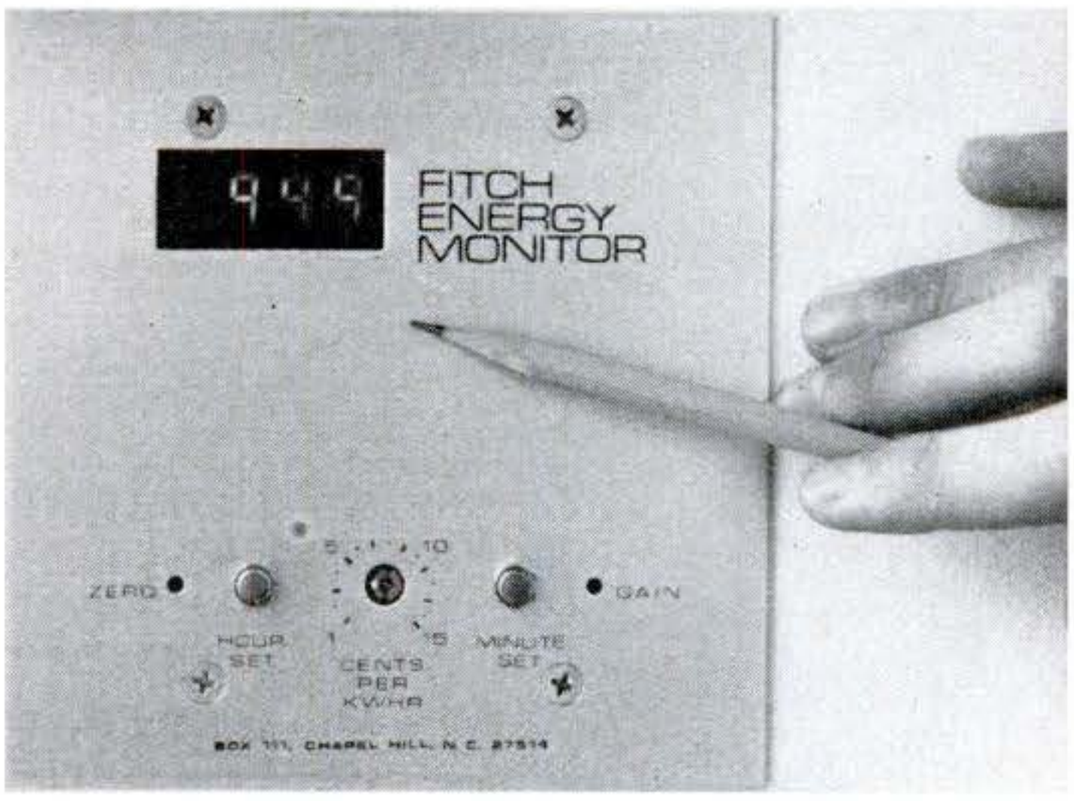
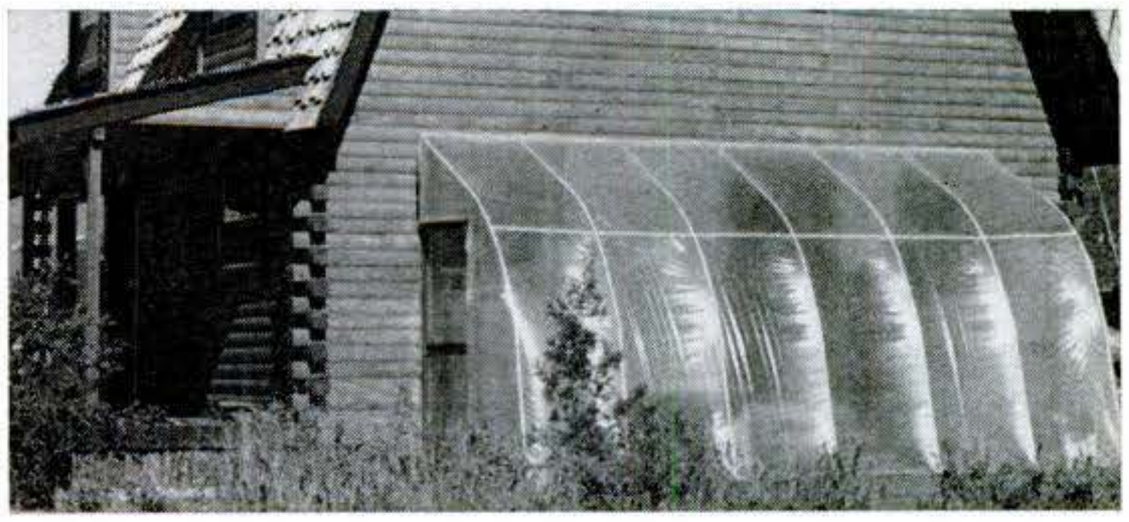
What's New IN HOME IMPROVEMENT

BY R. L. STEPLER

Sheathing

A polyisocyanurate foam core sandwiched between two aluminum foil facings gives High-R sheathing higher insulation values, says Owens-Corning. It comes in 3/8" to 2" thicknesses with R-values from R-3 to R-16. Owens-Corning, Toledo, Ohio 43659.





Electric monitor

How much electricity are you using? The Fitch Energy Monitor tells you in cents per hour. The device won't cut your energy consumption, but it should provide you with a strong incentive. It's $125 from Fitch Creations, 203 N. Greensboro St., Carrboro, N.C. 27510.

Solar add-on

Attach a Solar Room to the south side of your home and you'll get free heat from the sun. An aluminum frame holds the inflated Twin Skin plastic in position. The Solar Room Co. (Box 1377, Taos, N.M. 87571) has models from 12' to 39' long by 8' wide. Prices: $500 to $950.

Lighted numbers

You can put your address in lights with Numa-Glo. The 16"-by-4"-by-2" device, wired to your doorbell button or transformer, draws only three watts at 16 VAC. It's $22.45 from Residential Products Co., Box 1938, Ann Arbor, Mich. 48106.

Pattern painter

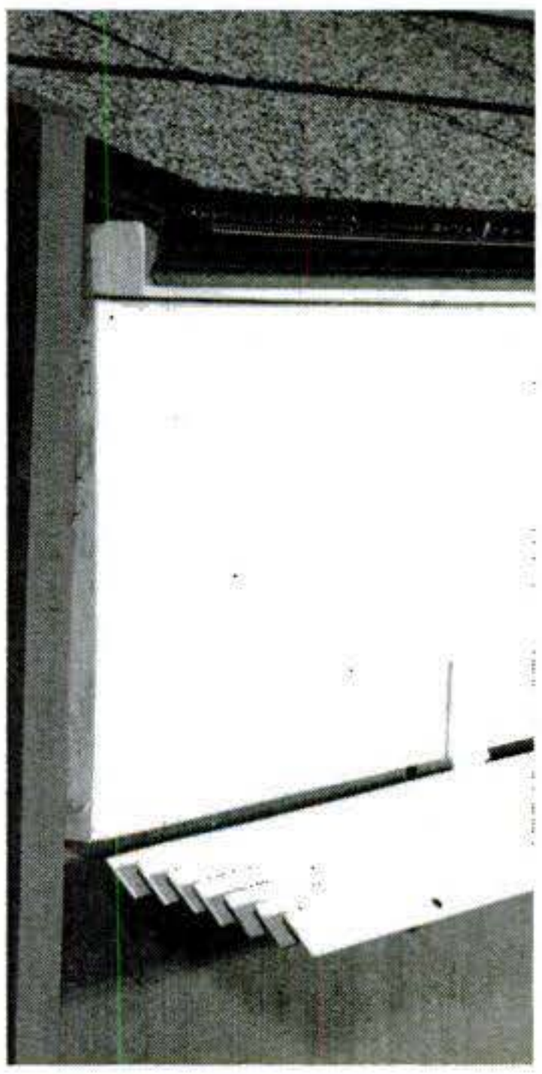
Can't decide whether to paint or wallpaper? The Faped Roller gives you wallpaper designs with the ease of roller painting. A brass tank holds the paint; a rubber embossed roller applies the design. It's $28.40 from Designer Paint Supply Co., Box 757, Silver Spring, Md. 20901.

Tile kit

You can install handmade Spanish-style tiles yourself with a kit from Old World Tile Co. (3971 E. La Palma Ave., Anaheim, Calif.). The kit contains five square feet of 6-by-6-in. tiles, grout, thinset, and sealer. Price: $14.95.

Ungutter

No leaf- or ice-blocked gutters, no clogged downspouts, with the Rain Disperser. S^2 Corp. (3 Washington Sq., Haverhill, Mass. 01830) says the gutter replacement deflects water droplets to prevent splashback and roof-edge trenching.



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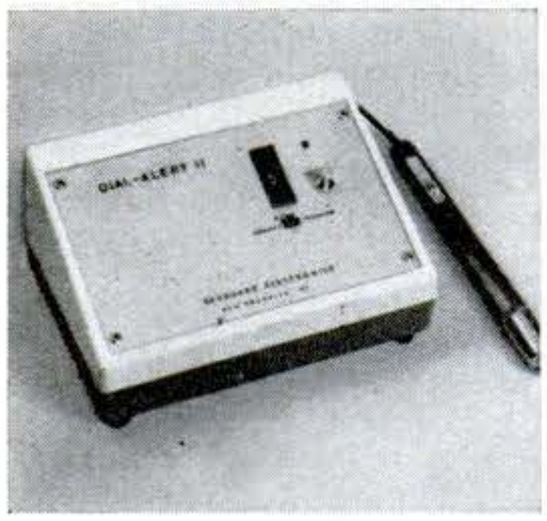
What's New IN ELECTRONICS

BY WILLIAM J. HAWKINS

CB marker

To be a good "good buddy," you've got to know your location on the highway in reference to others. And for that, there's this electronic Mile Marker by C. W. Inc. You set the starting mileage on the thumb-wheel switches when you first hit the green-stamp (highway) and press a button. The digital display then automatically keeps track of your mileage position, up or down the road, and in tenths of a mile. Since it merely connects to the battery and distributor, installation is fast and easy. The Mile Marker is $60.95 from C. W. Inc., Box 117, Canal Winchester, Ohio 43110.



Phone alarm

Connect Dial-Alert II to a phone line and conventional alarm sensors, and it will call you by phone if a burglar breaks in. A mike picks up all sounds and sends them over the line. From Seaboard Electronics, 70 Church St., New Rochelle, N.Y. It's $269.50.

Under one lid

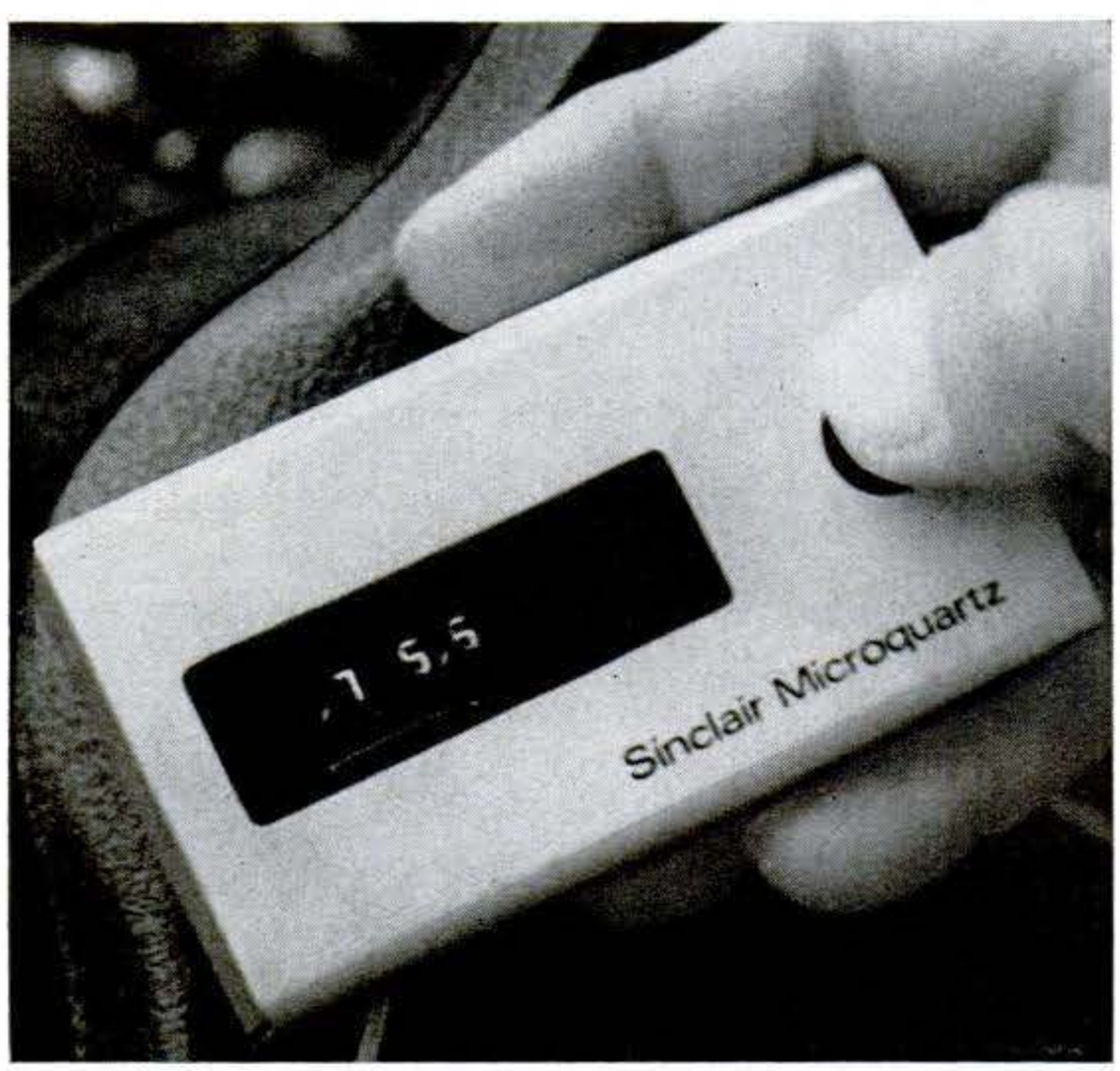
Optonica has gotten it all together—literally. Its new music center has fingertip sensing for FM tuning, AM and short-wave bands, Dolby noise-reduction system, cassette recorder, and belt-drive turntable. The Optonica SG-400 retails for $499.95.

AC/DC tester

Two light-emitting diodes replace the conventional neon bulb in this voltage tester (4.5 to 380V). Both LED's glow on AC voltage, only one on DC. They show polarity too. It's made by Siemens, Box 146, D-8510, Furth-Bislohe, Germany.

Microwave meter

Hold this meter up to your microwave oven for an instant readout of RF leakage. Model 245M, from UCE Inc., 20 N. Main, Norwalk, Conn. 06854, doesn't require batteries, and reads up to five milliwatts to cover HEW and FDA safe limits. $49.95.



Two-year timer

Pop in one set of batteries and the digital Microquartz will keep track of the time and date for the next two years. So says Sinclair Radionics, the makers. The small anodized case fits anywhere. A push button actuates the display. $19.95.

New mike

What's different about this in-dash CB rig? The microphone. It connects to any of four Sparkomatic CB models and adds automatic channel scanning and LED readout to the other features of the rig. Up/down button picks channel manually. It sells for $189.95.

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What's New
FOR YOUR CAR

BY RICH CEPPOS

Hidden winch

The Big Eight 8000-lb. winch mounts behind and under your RV's bumper so front-end appearance is little changed. It's controlled from inside or outside the cab via a 12-ft. control cable. It's $568.50; mounting kit is extra. Powerwinch, 217 Long Hill Cross Roads, Shelton, Conn. 06484.

Car lift

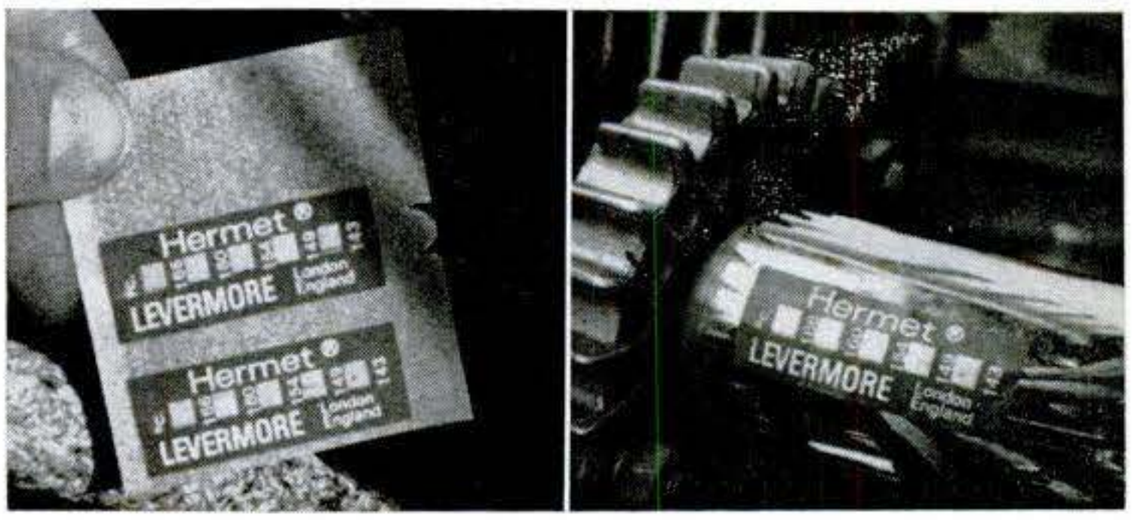
You can lift the entire side of your car for repairs with the hydraulic Easy Lift jack. It has a 3000-lb. capacity (a pair will lift a 6000-lb. car off the ground) and a mechanical safety lock to prevent jack failure. $90 each, $165 per pair. Easy Lift Co., Penfield, N.Y. 14526.

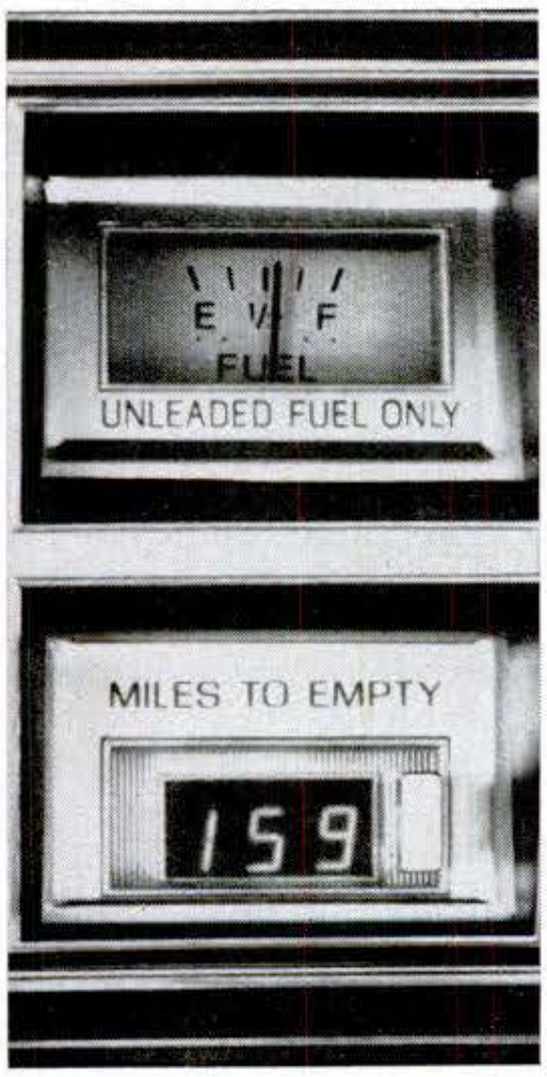
Glasses case

The Odyssey case keeps your glasses close at hand and off your car's seat. The ABS-plastic case mounts in your car's interior with a Velcro strip. Price is $5.95; chrome case is $12.95. Made by Safety Plastics, 1983 Coney Island Ave., Brooklyn, N.Y. 11223.

Heat sensor

A self-adhering heat-sensor strip indicates the temperature of your exhaust manifold or thermostat housing to within one percent. Strips measure to 260°C. Each strip has a 24° range. Levermore & Co. Ltd., 40/44 The Broadway, London SW19 1SQ, England.



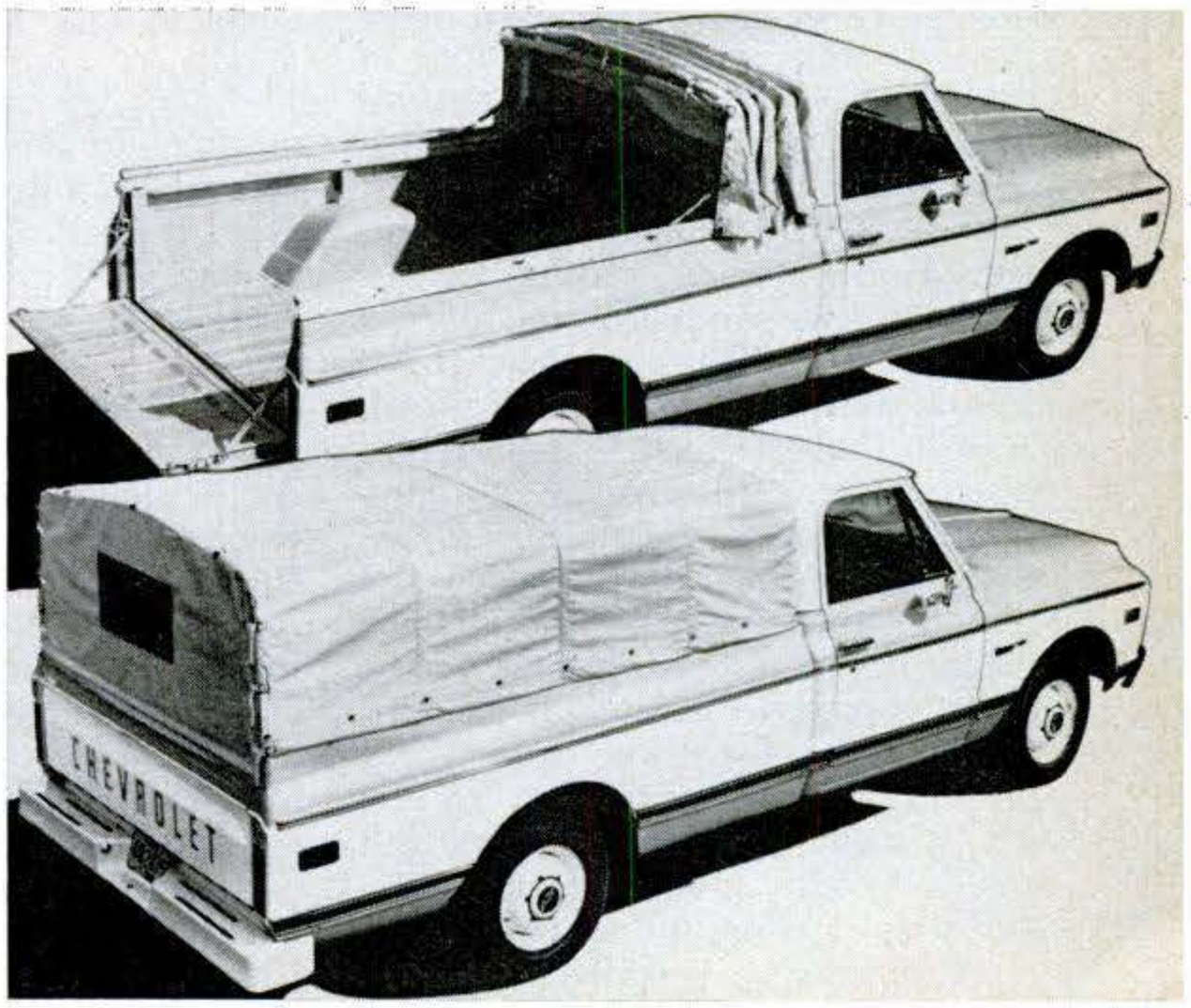


Mileage gauge

Owners of 1978 Continental Mark V's will never again have to guess how far they can go on the gas left in the tank. Once a minute, the Miles-to-Empty warning system's electronic processor considers instantaneous mpg and tank level, and flashes a mileage number.

Pickup convertible

In 30 seconds this sliding vinyl-coated nylon top transforms your pickup into a closed hauler or weekend RV. The bows slide on aluminum tracks. The unit can be installed in an hour, says Chalfant Sewing Fabricators, 11525 Madison Ave., Cleveland, Ohio 44102. $199.



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Longwall mining

–now there's a better way to get at the coal

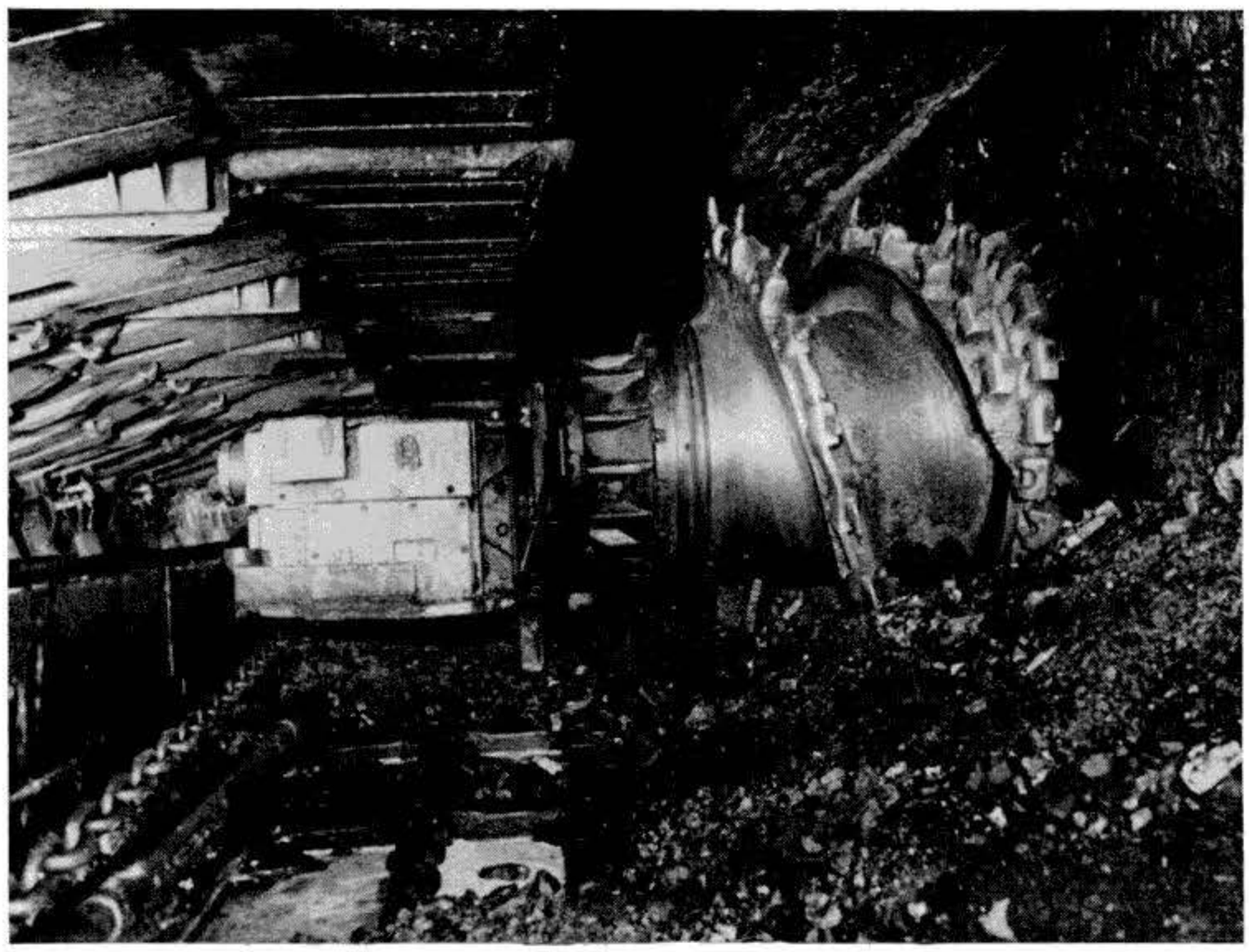
New technology is making coal mining safer, cheaper, less wasteful

By PETER BRITTON

The hills and valleys and fields and streams of much of our energy-hungry nation lie atop buried treasure—vast deposits of coal. At present rates of consumption, our domestic reserves could last up to 200 years. While research continues on renewable energy supplies—solar, wind power, hydrogen, and breeder reactors—the United States has a shiny black interim fuel to fall back on. And new ways to process coal so that it burns cleanly and efficiently are being rapidly developed. Technologies such as gasification and liquefaction [PS, Jan. '77, Mar. '74] and MHD—magnetohydrodynamics [PS, Mar. '74]—may make possible large-scale substitutions of coal for dwindling oil and natural gas.

But mining coal has always been fraught with problems—and dangers. Roofs may cave in, pockets of noxious gases can poison the miners, explosions and fires occur, ventilation is difficult, drainage is critical. Add to that the dust, the cold, and often the fear. In recent years, government safety regulations have helped to lower the risk for the miners. But the regulations have meant higher operating costs. Labor costs, too, have escalated. So coal companies must mine more coal faster to stay solvent.

Obviously, better ways to get the coal out of the ground are needed—and they're being found. One of the most promising is called longwall mining. In longwall, huge drum-shaped cutting heads called shearers travel the length of the coal seam's face, grinding out coal and dumping it onto a conveyor, which hauls it to the outside. The miners work under a protective canopy of steel supported by jacks or props. As the shearers complete a pass, the whole works—conveyor, canopy, shearers—is moved forward and the roof behind caves in. Longwall mining is faster, cheaper, and safer than other underground mining methods. The coal-recovery rate is much higher and the product is cleaner.



Huge cutting heads called shearers grind coal from mine face; conveyor hauls it away. Miners work under protective canopy of steel roof supports.

Longwall is still a relative newcomer to the domestic mining scene, although it has been widely used in Germany and Great Britain for some time. In 1976 only about four percent of the coal mined in this country was mined by the longwall method. Surface mining—strip mining—now accounts for more than half of our domestic coal production, but concern for the environment has made the method increasingly unpopular. Consequently, our underground mines will have to produce an ever-greater share of our coal.

Now, 60 percent of the coal that's mined underground is removed by the so-called continuous mining method. This uses a continuous mining machine to grind coal from the face, dump it for travel to the outside, and then return to its mining task. This system, however, is far

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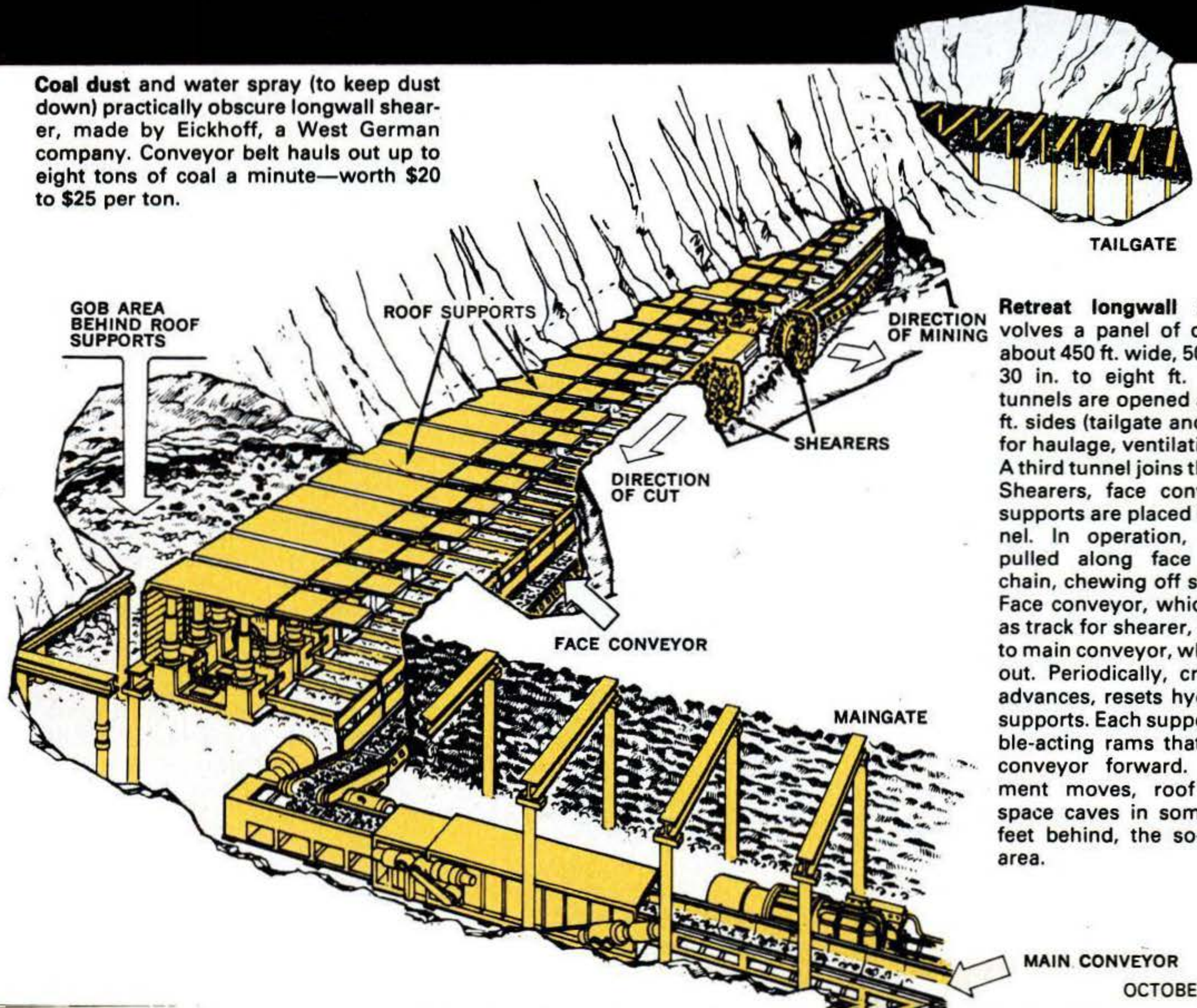
Coal dust and water spray (to keep dust down) practically obscure longwall shearer, made by Eickhoff, a West German company. Conveyor belt hauls out up to eight tons of coal a minute—worth $20 to $25 per ton.



Retreat longwall mining involves a panel of coal usually about 450 ft. wide, 5000 ft. deep, 30 in. to eight ft. high. First, tunnels are opened along 5000-ft. sides (tailgate and maingate) for haulage, ventilation, escape. A third tunnel joins them at rear. Shearers, face conveyor, roof supports are placed in third tunnel. In operation, shearer is pulled along face by heavy chain, chewing off slice of coal. Face conveyor, which also acts as track for shearer, carries coal to main conveyor, which hauls it out. Periodically, crew lowers, advances, resets hydraulic roof supports. Each support has double-acting rams that push face conveyor forward. As equipment moves, roof of mined space caves in some 10 to 15 feet behind, the so-called gob area.

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from continuous. One study shows that only one hour in an eight-hour shift is actually spent mining. Another mining system, conventional mining (a cycle of support, cut, drill, blast, and load), accounts for most of the rest of our underground coal production. With both of these systems, about half of the coal must be left as columns to hold up the roof via the so-called room-and-pillar method (see diagram).

A handful of American firms began examining longwall mining in the early 1960's as a last-resort method for mines with steeply pitched seams or tricky roof conditions. But it took three things to galvanize the industry into a swing to longwall: First, the Mining Health and Safety Act of 1969, coupled with various United Mine Workers Union contract negotiations, put a number of difficult restrictions on mine operators. These cut down production to the point that some mines were forced to close. The cost per ton was becoming too high to bear.

Secondly, the energy crisis sowed the seed for a potential big increase in production as well as a need for increased recovery of another nonrenewable resource. It has been estimated that about one quarter of our coal has already been lost due to wasteful mining techniques; longwall can practically eliminate that.

Thirdly, the British and Germans developed in the early 1960's a new kind of extremely strong, self-advancing roof support. This made longwall mining vastly safer than it had been and increased productivity while reducing the number of men employed. In the early 1970's, conditions were finally right for serious introduction of longwall mining in the United States.

Shoemaker Mine

On a chilly, foggy day recently, I paid a visit to Shoemaker Mine in West Virginia, run by Consolidation Coal Co. (Consol), a subsidiary of Continental Oil. Shoemaker is one of only 72 mines in the U.S. (out of a total of 3000 underground coal mines) that use the longwall system. Pat Callebs, general superintendent at Shoemaker, got there long before I did. His phone had jangled at 4:30 a.m. with an important message: A longwall shearer had broken down and things looked bad.

"When the shearer goes out, as it does normally for two or three hours about twice a week," he told me, "we take it in stride. But today it looks like we may have a two- to four-shift shutdown. That means as much as $25,000 worth of coal per shift that's not coming out. And them's big dollars."

Soon we were fitted with light-equipped hard hats and emergency breathing devices that would provide about one hour of air. A high-speed elevator deposited us at the foot of Shoemaker's southwest portal shaft. Two hundred eighty feet down, we clambered aboard a dingy orange rail car. Callebs affixed the trolley pole to the 275-VDC wire, and we clanked away at some 12 mph through a long tunnel sprayed white with limestone to keep down coal dust. At the end of a slow, six-mile journey, we hopped out of the car, walked through several tunnels, and came upon the conveyor belt that removes the constant flow of chopped-up coal at a rate of up to eight tons a minute. We followed the belt to where it met the face conveyor, a chain-type belt that takes the coal from the face area. All machines were ominously quiet except for an occasional jockeying of the shearer into position for removal of the small internal gear that caused the breakdown. "Hey, Pete, let's go see the shearer," Callebs shouted as he ducked his six-foot, six-inch frame in under the roof supports. He practically sprinted 75 yards along the narrow, 4½-foot-high pathway between coal face and conveyor. When I breathlessly caught up, he was talking to the crew chief in charge of repairs.

> "Underneath that row of 90 roof supports is the safest place in the mine"

Behind the two men was the forward drum of the shearer, up to its hub in its last bites of coal. When working, this leading drum—4.3 feet across, with 40 tungsten-carbide-tipped bits—revolves at 60 rpm, cutting away a 30-inch-deep strip of coal next to the ceiling. The identical trailing drum, 25 feet back on the far end of the machine, takes off an equal swath at floor level. Together they can remove and pulverize a band of coal 435 feet long by 5.5 feet high by 30 inches thick in as little as 35 minutes. Callebs figures that a one-foot-thick slice of the entire face equals about 100 tons of clean (processed) coal. The average market value per ton of this steam-grade bituminous is around $20. It may bring more.

Squatting there, listening to Callebs and his longwall crew chief discuss their shearer problems, I could begin to understand his assessment of longwall crews: "They're a breed apart," he had said admiringly. Their work place is a tiny crawl space beneath a row of roof supports called shields. It places the men within a few feet of the normally roaring and fuming shearer. Yet, Callebs told me, underneath that row of 90 roof supports is the safest place in the mine. Each of these massive, hydraulically operated nine-ton shields has two jacks that can support nine tons per square foot; other kinds can support up to 300 deadweight tons.

The way longwall mining works is simple enough; the trick is to keep it working in that rough environment.

The method used at Shoemaker Mine is called retreat longwall mining. The diagram shows you how it works. With retreat longwall, getting the site ready for mining—especially opening the three tunnels—is a lengthy process. It can take up to 10 months to prepare for the mining. Interestingly, coal removal may take only half that time.

A second longwall technique is advance longwall. This eliminates tunneling prior to mining and is faster to set up. But such problems as ventilation and haulage make it less popular. A third method uses a combination of the longwall roof-support system and a shorter face with a continuous mining machine. This is known as shortwall mining and is gaining acceptance in some areas.

Longwall R & D

It is estimated that a longwall system is worth about four continuous miners now, but more improvement is needed. Therefore, new methods and equipment are being developed to increase safety, production, and speed.

Western coal is currently the subject of much debate and hope. It is lower in sulfur content than much eastern coal and lies in great abundance in Colorado, Montana, and Wyoming in both surface and underground seams. The western seams, however, may be steeply pitched, up to as much as 75 degrees from the horizontal, and of thicknesses ranging from 20 to 90 feet and more, sometimes closely spaced. The U.S. Bureau of Mines is currently working with two companies, Consol and FMC Corp., on new variations of longwall mining to meet these different conditions. One is a "top slicing" technique

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industry gears for greatly rising demand

for mining thick (20-30-foot) seams. In this, as many as four levels are mined consecutively. A second idea involves "sub-level caving." A bottom slice is removed, the remaining coal is allowed to cave in, and a "gob-side" conveyor carries coal from the caved-in section.

The Bureau of Mines is also undertaking a lot of experimental work at its Pittsburgh Mining and Safety Research Center in Bruceton, Pa. Gene Palowitch, deputy director of research there, talks of automation. "The remote control of shearers by one or two men (there are now about 10 in a crew) is under investigation. The ultimate goal would be to run the entire operation from the maingate. This will have to come, especially in the lower seams. It's awfully hard on a guy to have to crawl up and down that face in low seams six or eight times a shift."

Another interest of the Bureau, according to Palowitch, is being able to find the exact location of the floor and ceiling interface of rock and coal. Greater accuracy would allow for more complete recovery of coal, cut down on the wearing of shearer bits from striking rock, and greatly reduce the chance of a spark from such a contact that could ignite methane gas. Palowitch says that operators must now largely guess where shearer drums are, which is difficult with the machine going from 10 to 20 feet a minute in heavy dust and water spray. Consequently, several devices are now being worked on. NASA's Marshall Space Flight Center in Alabama has been contracted to do a large part of that research, using aerospace technology. The five major devices are:

- A VHF radar system that is mounted on the shearer and would point at the roof and measure the changes in the dielectric constant of the materials its signals hit.
- A sensitized pick on the shearer (developed by Joy Manufacturing Co.) that has a capacitance transducer that measures the force of the pick cutting into various materials. Radio signals are also being used.
- A reflectometer, which uses light waves to measure color differences in surface material, and a penetrometer, which measures the penetration hardness of materials by taking the recoil force of a rod bounced off the material.
- A vibration-analysis sensor, which uses an accelerometer to translate machine vibrations into material being cut.
- A nucleonic sensor, developed by Britain's National Coal Board, has a radiation source of 100 millicuries of americium. The intensity of gamma radiation collected from backscatter is a function of how much coal is left.

Several systems would be used together to obtain a "referee" consensus or vote-system of measuring, says Palowitch. "We're not looking to reduce the number of men working the longwall face," he notes. "Ten men at $1000 a day in wages is a pittance when you're talking about up to 6000 tons of coal in the neighborhood of $25 a ton. What we're after is safety, recovery, and lessened downtime."

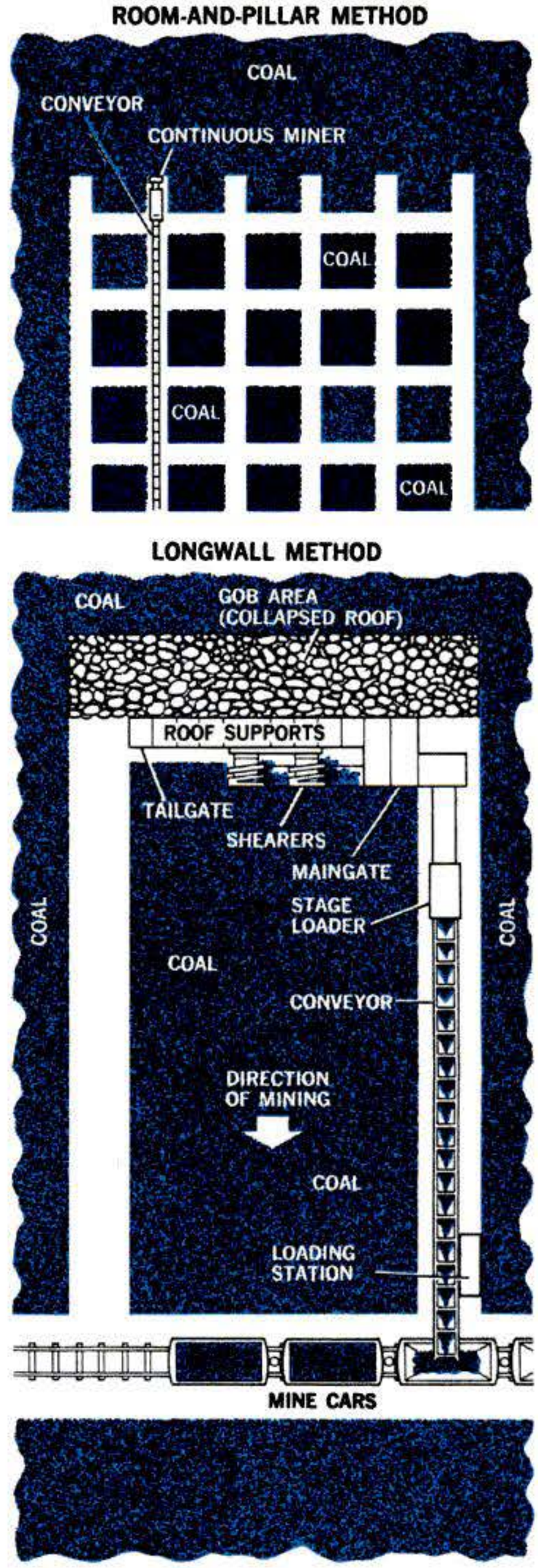
Best way to go

Despite the newness of longwall to American mines, the high cost and intricacy of equipment, and attendant operating problems, longwall seems to be the best way to go. Experts like Pat Callebs say that in 10 years, up to 30 or 40 percent of all coal will be longwalled. A good measure of longwall's potential may lie in a rather astonishing world record. In January, 1976, a Consol mine in West Virginia set a coal-production record by mining 12,395 tons in one 24-hour period from one longwall face—about 400 tons per man per shift. An average longwall shift figure is around 80 tons per man. One man operating a continuous miner can mine about 25 to 50 tons of coal in an eight-hour shift; a man with a pick and bar can mine up to 10 tons in the same time.

Today, most of the equipment is made in England or Germany, but several American firms have already marketed complete longwall lines. Joy is one, and it manufactures shields, shearers, and conveyors in its Franklin, Pa., facility. It is currently introducing a shearer that eliminates the dangerous haulage chain and runs instead on a rack-and-pinion principle. Also under development: caliper shields that better resist sideways movement.

As we moved back to the rail car, Callebs told me: "It's a tough business; you have to press, press, press. We do a good job of keeping the face going day in, day out, keeping crews working, the equipment in readiness, people motivated, ventilation good, belts moving." One of the big problems, he says, is moving the equipment to a new face after one 500,000-ton coal panel has been exhausted. Speed is critical, with $5 million worth of equipment lying idle. It usually takes about two weeks to move the heavy equipment to the next site. Moving is also the most risky portion of the operation.

Back in his office, Callebs said, "I really like longwall mining. I'm just about to finish my millionth and a half ton of longwall coal here. Consol's other three mines in the valley here are scheduled for longwalls. Next year at Shoemaker we'll get a second one in the five-north sector. When the mine adjusts to that—to such things as haulage, maintenance, parts—we'll be getting half to three quarters of our yearly average of two million tons from longwall. We've already done half of a 12,000-ton day by longwall. Longwall demands more—but then you get a lot more back." PS



Room-and-pillar method (top), used with both continuous and conventional mining, leaves about half of coal as pillars to support roof. In longwall mining, steel roof supports protect operation so no pillars are needed. Recovery rates as high as 90 percent are possible; in practice, 70 to 80 percent is common. Surface subsidence is also easier to predict and control.

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First really promising U.S.

man-powered aircraft

It's 30 ft. long, stands 18 ft. tall, spans 96 ft., weighs 77 lb.—and might just collect Kremer's $86,000

By PAUL WAHL

Even for a man-powered aircraft, the Gossamer Condor is a strange bird. Big and spindly, it looks like a cross between an indoor model airplane and a rigid-wing hang glider. It has the wingspan of a Boeing 737, yet weighs only 77 pounds. And it flies tail-first at a lazy *nine* miles per hour.

Someday, perhaps soon, this sky cycle may earn a whopping $86,000 for less than 10 minutes of pedaling by winning the Kremer Prize, aviation's richest purse. It will go to the first man-powered aircraft to fly a figure-eight course around two markers a half-mile apart, crossing both starting and finishing lines at an altitude of at least 10 feet.

Established in 1959 with the sponsorship of British industrialist Henry Kremer, this competition has inspired the building of a number of man-powered aircraft in the United States. But, until this one came along, the few that ever got off the ground have been disappointing performers.

After some 400 flights since last fall —in itself an impressive record—the American Gossamer Condor has now become the number one contender for the Kremer Prize. It has outdone its sole rival, the Stork [PS, May '77], by staying aloft for five minutes 15 seconds, to better the Japanese plane's four minutes 28 seconds. Much more significant, the Gossamer Condor has flown figure eights, something that no other man-powered aircraft has accomplished.

To put this feat in perspective: Of the 20-odd pedal planes that have flown since 1961 (besides the Gossamer Condor), only the British Puffin II more than a decade ago and the Stork in 1976 have managed even 180-degree turns.

According to recent reports from Japan, the Stork has had difficulties in making turns (perhaps in attempting figure eights). The plane has been in downtime lately while the wing was rebuilt to improve handling during such maneuvers. Also, it has been fitted with electric motors to relieve the pilot of pedaling during practice sessions, permitting him to concentrate on the problems of turning.

With its complex airframe, painstakingly built of spruce and balsa, the Stork is basically an updated and scaled-down version of the British Jupiter, a classic design of the same Sixties generation as the Puffin II. It represents the best of the old, while

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the Gossamer Condor is the first of a breed of simple, efficient sky cycles.

Designer-builder of the plane is Dr. Paul B. MacCready Jr., well-known aerospace scientist and president of AeroVironment Inc., a Pasadena, Calif., firm described as "providing services and research in the atmospheric environment." A veteran pilot of both airplanes and sailplanes, he is a former world and national soaring champion, and flies hang gliders, too.

"I was thinking of hang gliders and about the indoor model airplanes that I built many years ago," Paul MacCready told me, "and I got this idea for a man-powered aircraft that could win the Kremer Prize." That brainstorm resulted in Gossamer Condor.

The optimized airfoil designs used in the craft were developed in computer studies by the noted aerodynamicist, Dr. Peter B. S. Lissaman. Formerly professor of aeronautics at Caltech, he is now vice-president of AeroVironment Inc.

Another key member of MacCready's team is engineering consultant Jack Lambie, who is famous in hang-gliding circles as a pioneer of the sport and designer of the popular Hang Loose glider. He also built and flew replicas of the Wright 1902 glider and 1903 Flyer for the 1971 NET-TV documentary on the famous brothers.

The Gossamer Condor represents an innovative approach to design and construction. A parasol-type monoplane, this machine has its wing suspended 10 feet above the fuselage, while the horizontal stabilizer (which also provides lift) is out in front.

Overall, the aircraft is 30 feet long and stands 18 feet tall. Its wing spans 96 feet, has a root chord of 10 feet and a tip chord of five feet. The stabilizer has a span of 24 feet and a chord of five feet, is mounted on an 18-foot boom. Empty weight of the plane is 77 pounds. With a 140-pound pilot aboard, the wing loading is about four ounces per square foot.

The pilot sits in a semi-reclining position with his seat at about pedal level. A long drive chain, twisted 90°, transmits the pedal power to the 12-foot pusher propeller, the blades of which are similar to model-airplane wings and are adjustable to vary pitch. There is no driven ground wheel, a feature of most man-powered aircraft. Landing gear consists of two five-inch toy wheels fore and aft.

The prop turns at 110 rpm and the power required to fly a 140-pound pilot is about 0.37 hp. Ergometer studies, using a specially modified exercise bicycle that provides a readout in horsepower, indicate that a champion cyclist can sustain an output of 0.5 hp for 10 minutes. That's long enough for the Gossamer Condor to fly the Kremer Course.

The control wheel is mounted on a pivoting shaft. Turning it rolls the stabilizer to control yaw. Pushing the wheel up or down tilts the stabilizer vertically to bring the nose down or up. For turning, the wing is warped by pushing or pulling a separate lever.

Although man-powered aircraft typically are tricky to pilot, MacCready says that the Gossamer Condor is a docile bird, so easy to fly that anyone can learn to handle it in a few sessions. However, its very light wing loading, large wing, and unusually low airspeed make the machine highly sensitive to wind. Although it has been flown in winds up to seven mph, turns are not feasible if wind velocity exceeds two mph. It will need almost a dead calm to fly the Kremer Course successfully.

The airframe, suggested by hang-glider construction, is built of aluminum tube, chemically milled for lightness, in diameters from ¼- to ⅜-inch for the ribs, to two inches for the wing spar, keel, and vertical post. Piano wire provides bracing. The double-surface wing and stabilizer are covered with ½-mil Mylar, material also used in the streamlined fairing that surrounds the pilot.

Because of this simple construction, the Gossamer Condor originally was built in less than eight weeks at a materials cost of under $2000. The concept has made possible numerous modifications, including six major redesigns in as many months. With most other man-powered aircraft, such work would have taken years. Repairs can be made quickly; no damage has required more than 24 hours to fix.

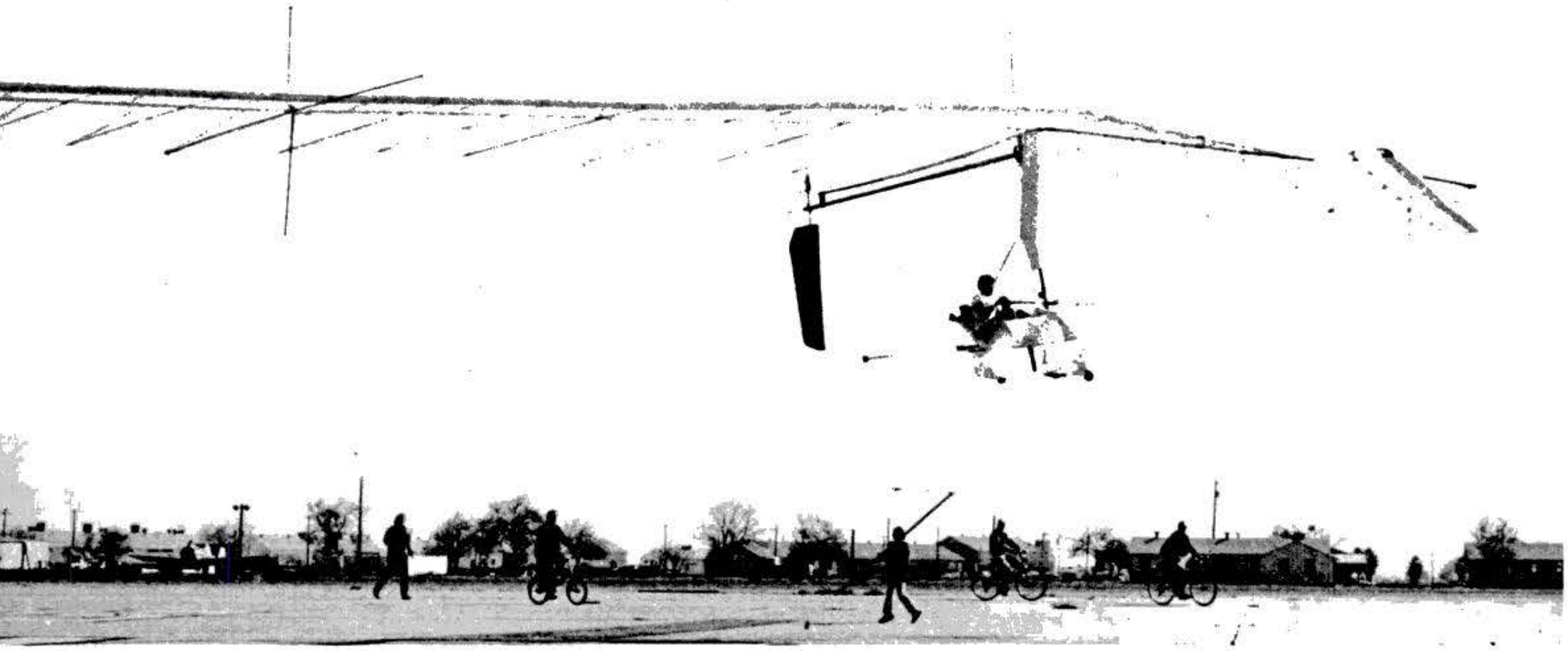
It looks as if the Gossamer Condor concept may evolve into a generation of home-built sport sky cycles. Equipped with model-airplane engines, some could be "flying mopeds." Plans for the Kremer Competition Gossamer Condor—and maybe a more compact version for fun flying—will soon be on sale. For details, send a stamped, self-addressed envelope to Gossamer Condor, AeroVironment Inc., 145 Vista, Pasadena 91107. PS

FOR FURTHER READING

Man-powered Flight, by D. A. Reay, $15, Pergamon Press, Inc., Maxwell House, Fairview Park, Elmsford NY 10523.

Man-Powered Flight, by Keith Sherwin, $7, Rainco, P.O. Box 20944, Phoenix AZ 85036.

Popular Science, Jan. '71, Mar. '72, Feb. '74, May '77.



Cruising at only nine miles per hour, the American Gossamer Condor may be the world's slowest man-carrying airplane.

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Atrium house

–you build it in stages for progressive privacy

By AL LEES

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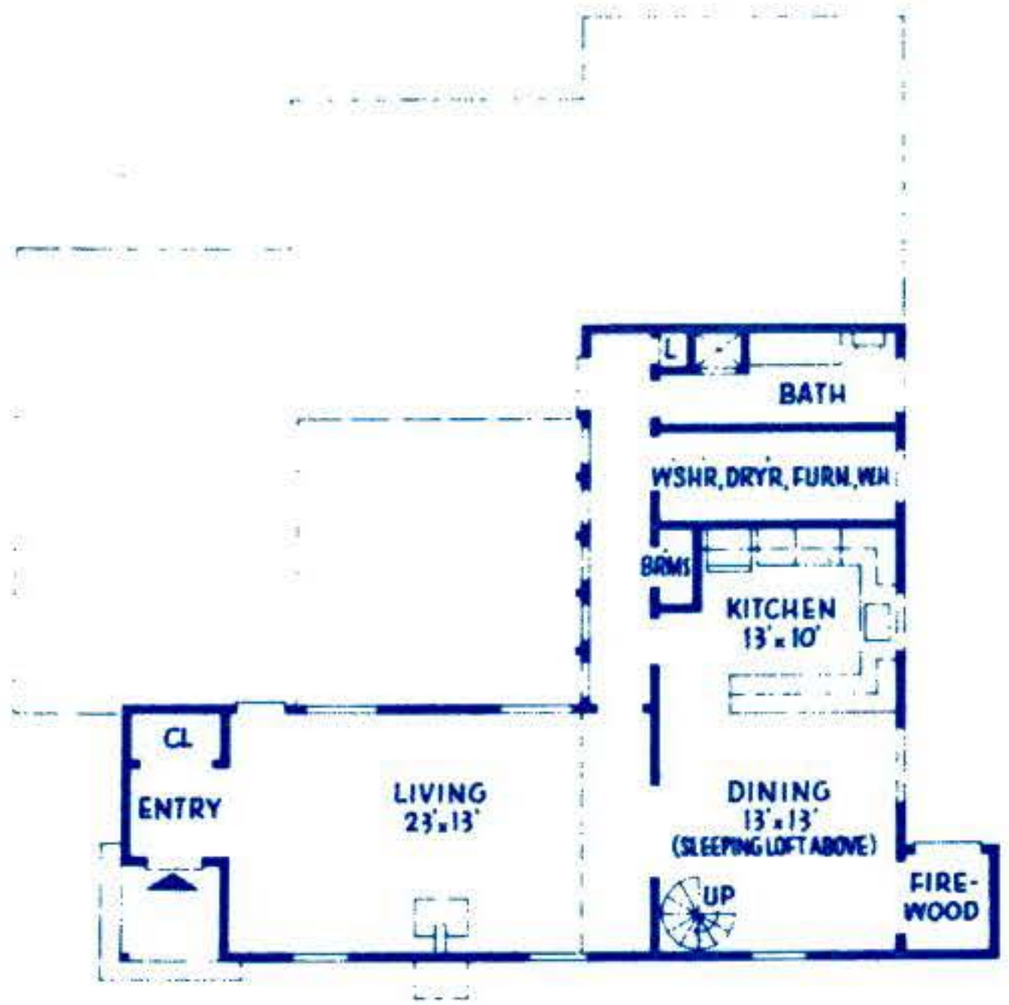
In our constant search for house plans that offer fresh solutions to site problems, we commissioned William J. Ward, Jr., AIA, to design a house that could be built in stages, as budget and time allowed. We wanted an initial stage that—for a modest investment—would offer all amenities, but would lend itself to expansion as family size (and income) increased. Ingenious architect that he is, Ward devised stages that wrap themselves around a central atrium—an approach we find intriguing enough to recommend for primary housing as well.

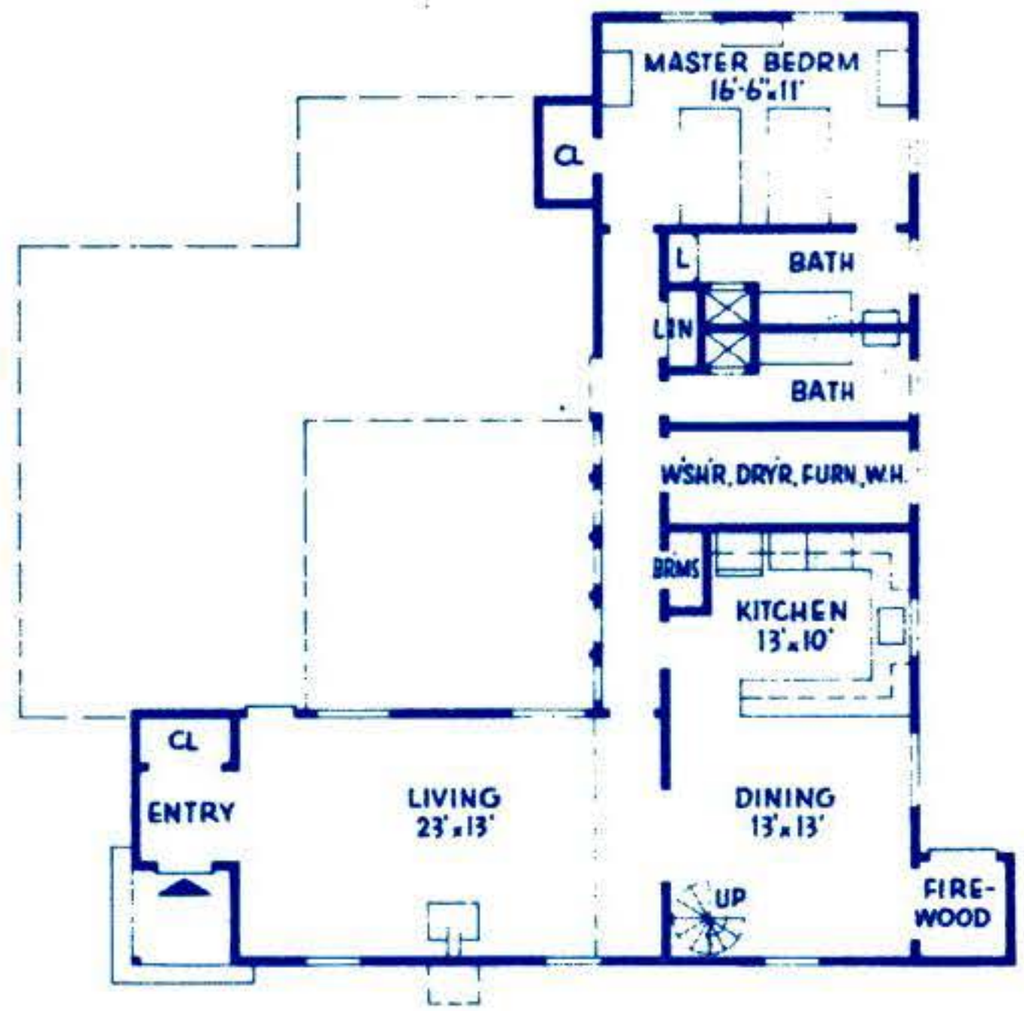
But it could prove particularly appropriate for a leisure-home site. Just suppose: When you buy your plot, nobody's yet built on lots to your left or behind, so you face the first-stage L that way and enjoy a sheltered patio in the corner. Then, as your development grows and neighbors press in, your house additions solve both your space and your privacy problems: Add two bedrooms and you've created a U that screens the patio from three sides. If someone then builds on your open side, you simply complete the atrium with an arcade and a shingled wall that can

[Continued on page 172]

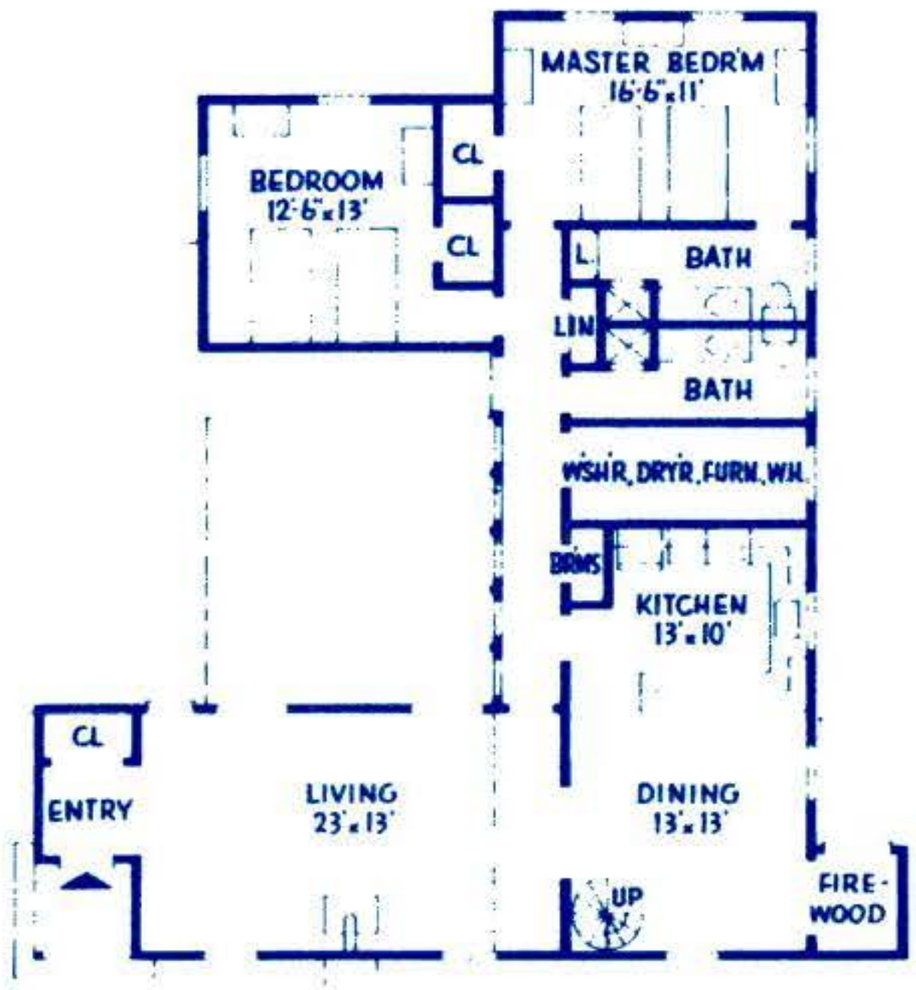
Start with this basic L . . .



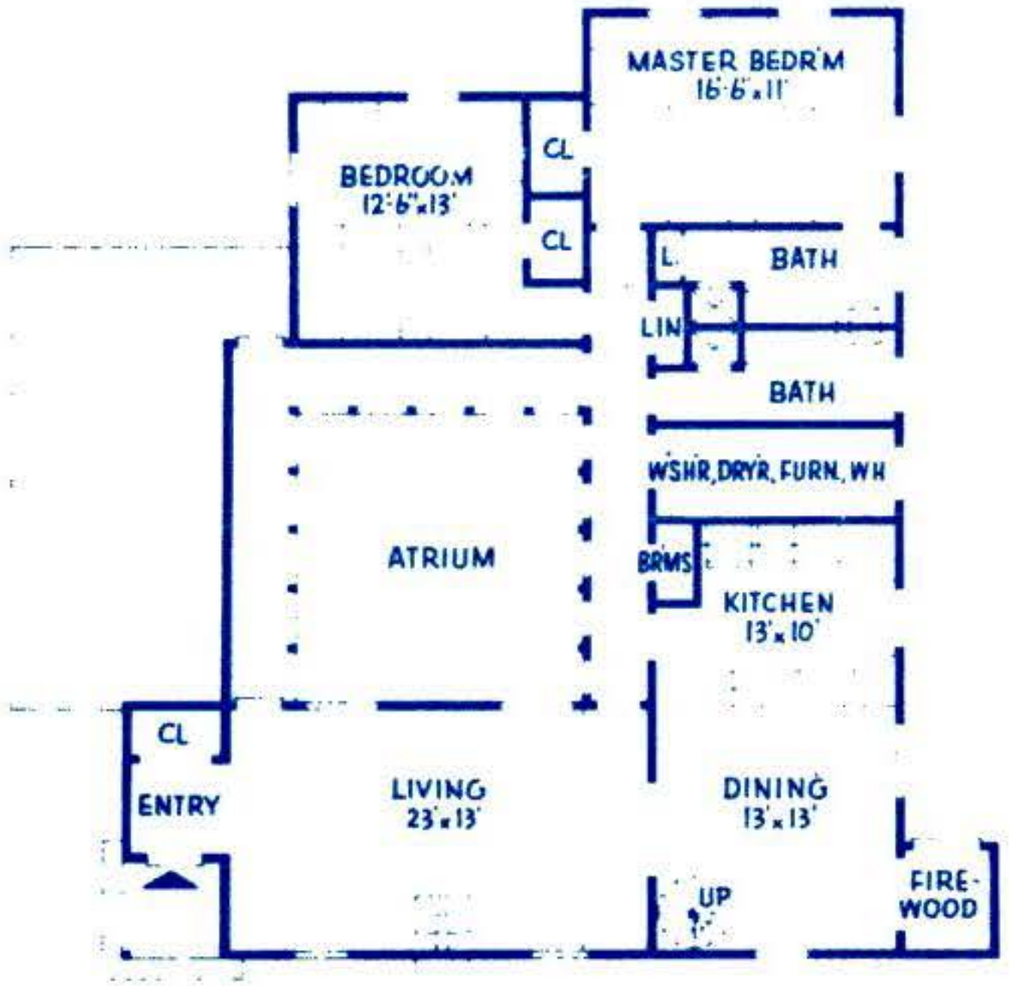
. . . add a master bedroom and bath



. . . tack on a second bedroom



. . . erect a privacy wall to close the atrium



. . . and complete the circle with guest cabins.

STORAGE WINGS
For a closetless room, ample cabinets that form this alcove offer welcome storage. To set off alcove, cement matching carpeting on front of bed and walls of recess. Pattern is a Congoleum carpet of Allied Chemical's Anso nylon.

Bed alcoves

Take your pick of two built-in treatments to perk up a plain single bedroom

By AL LEES
PLANS BY CARL DE GROOTE FROM SKETCHES BY CARL SIGMAN

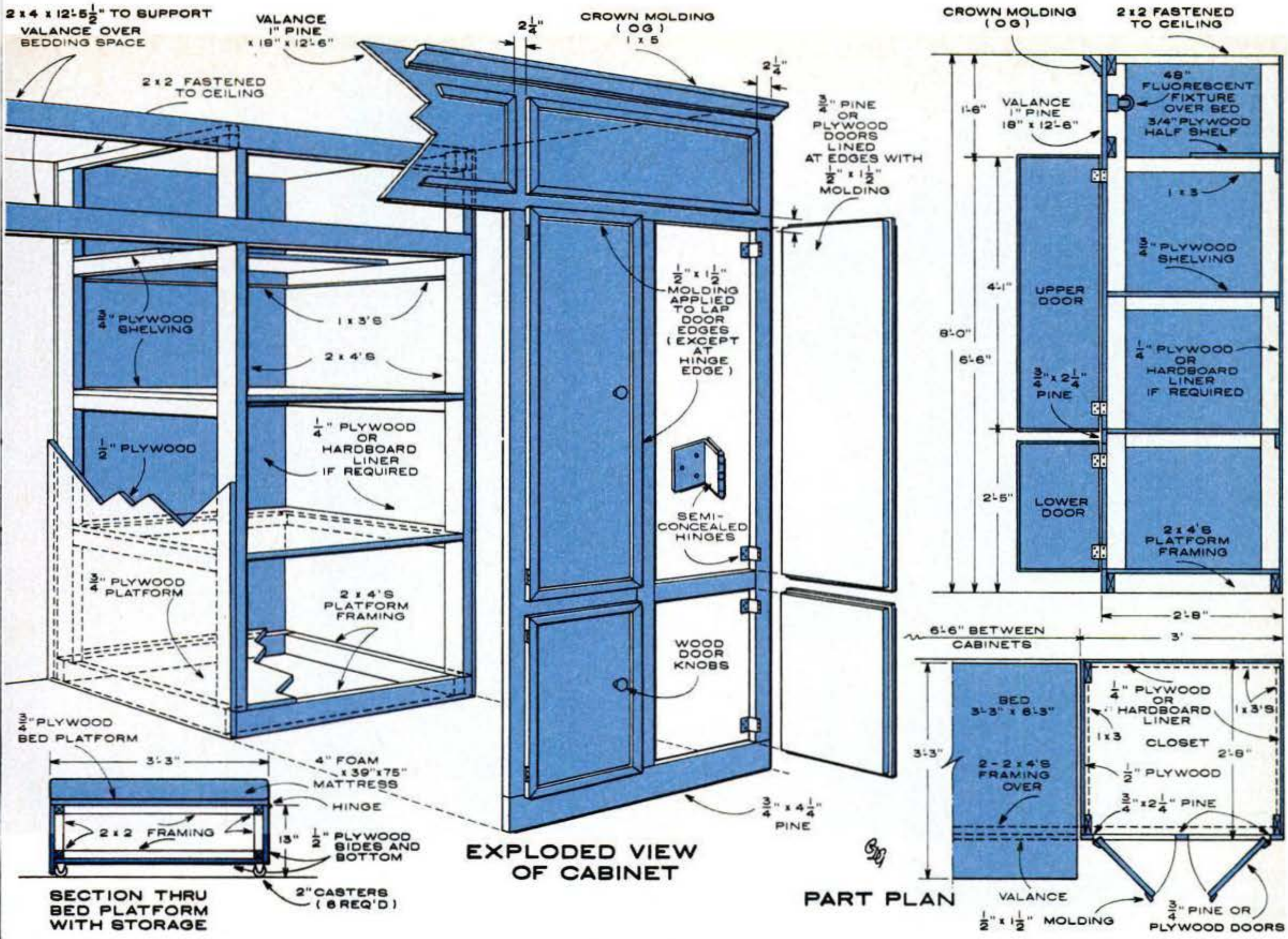
Whether it's kept for an occasional guest or regularly occupied by a family member, the single bedroom is often devoid of style and short on function. Here are two clever means of adding drama to a "nothing" little room with a bed in it.

The only thing they have in common is their use of plywood for flanking cabinets that create a bed recess. In one case, the recess replaces a conventional headboard treatment. The other takes the "daybed" approach by alcoving a bed sideways.

Construction is easier than it looks. For the cabinet doors, mitered moldings are cut oversize and glued and bradded around panel edges with enough projection to provide a stop against the door frame (except at hinge edge).

For shadowbox displays, cut both front panels to size and lay out, on each, a balanced grouping of "windows" of varying sizes to match the objects you'll display. Cut these carefully with a saber-saw blade inserted through a hole drilled in a corner of each. Glue and nail matching boxes on back and paint the assembly before adding Plexiglas tops. PS

DISPLAY WINGS
To display a collection of artifacts, nothing beats niches lighted from above. This treatment also offers concealed storage: Counters flanking bed have hinged tops that project at front to provide finger-lift—for extra bedding.



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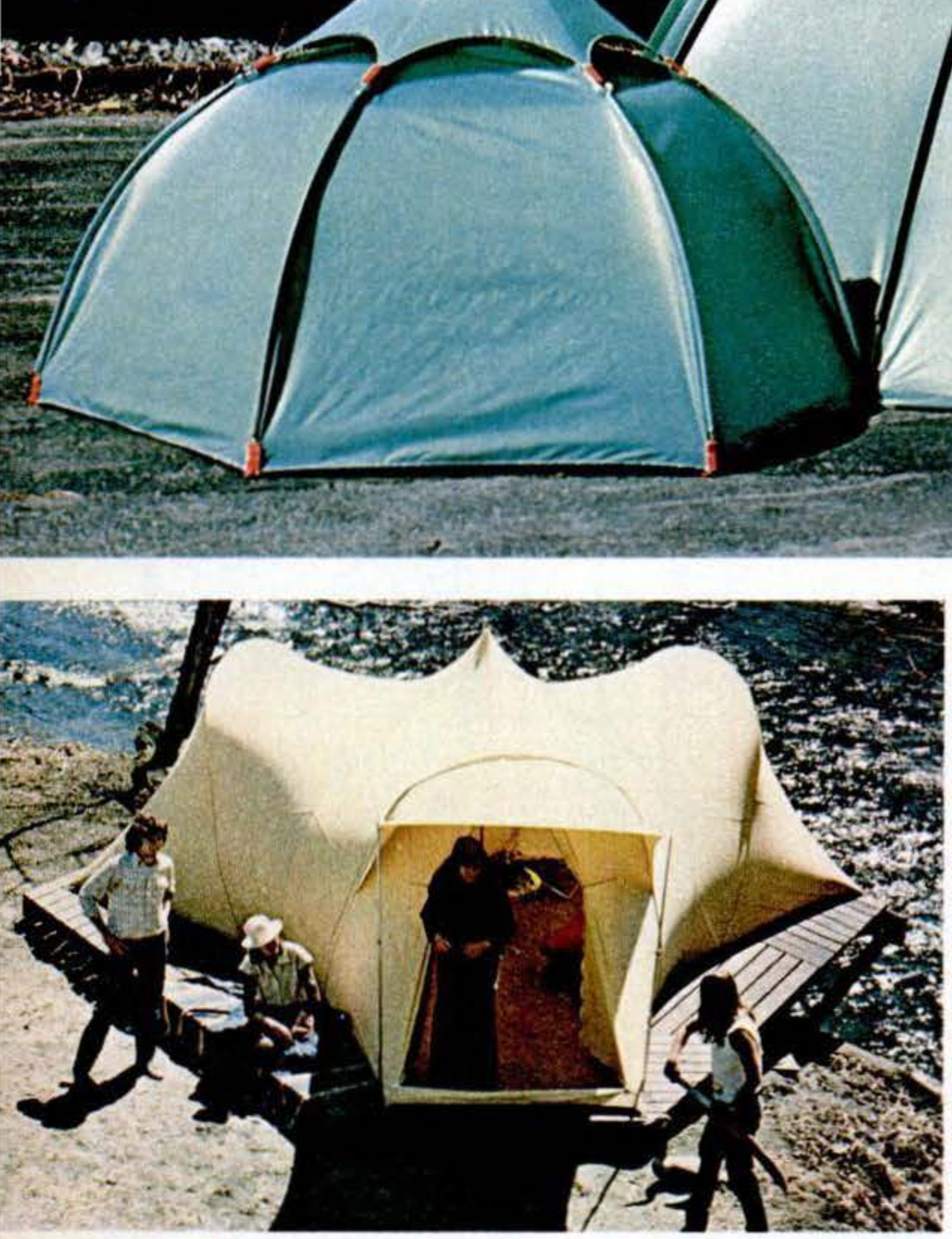
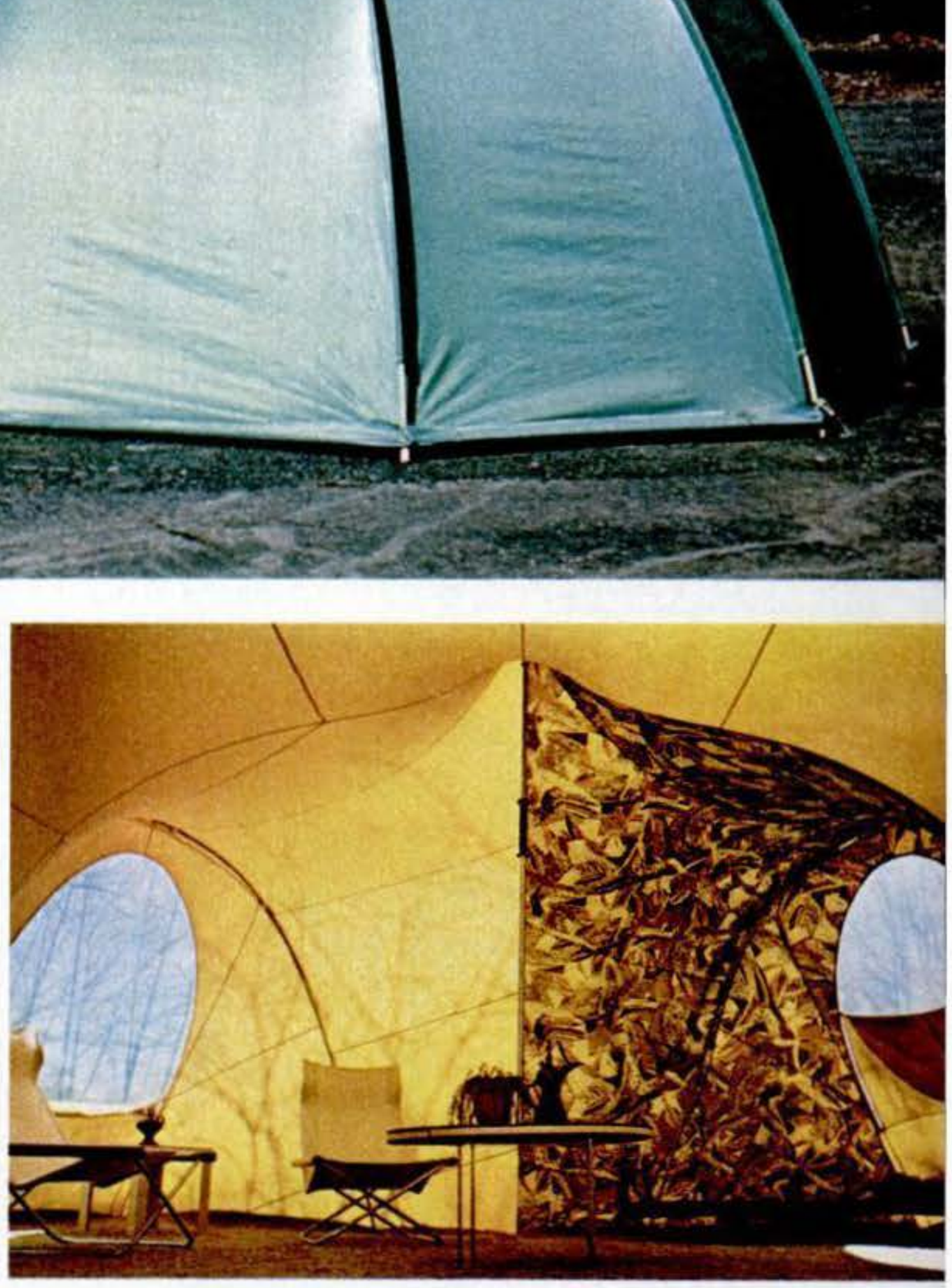
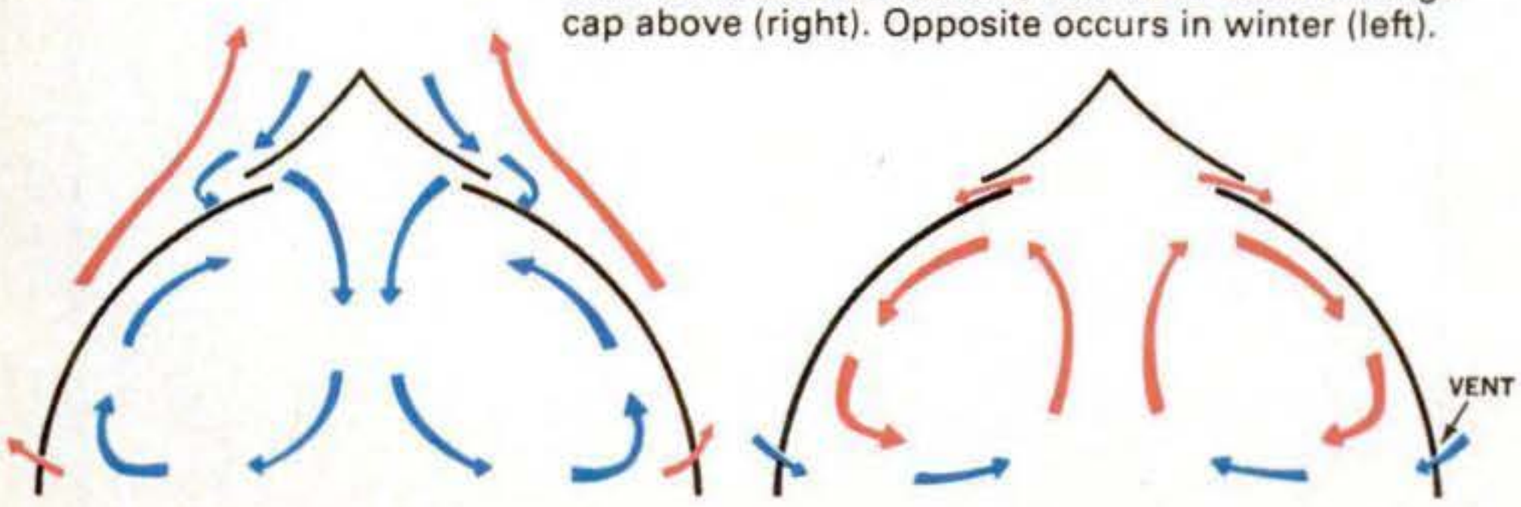
Clever engineering shapes new **tent designs**



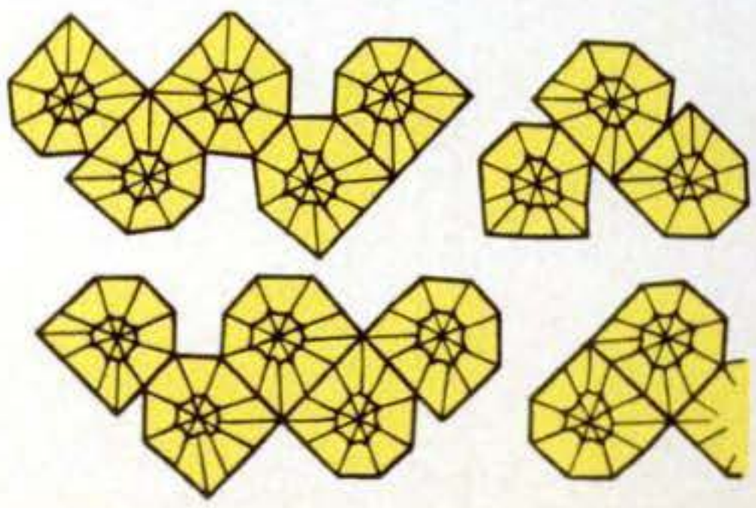


Graceful, lightweight arches make for spaciousness in Optimum, spreading the tent into three bays around a single pole. Double-layer cotton—the interior sheeting a decorative pattern—traps heat and insulates the interior.

Ventilation airflow results from airdrop's hemispheric shape (below; photo at top), plus exterior cap and parabolic openings at bottom of each panel. Cool air enters at bottom; warm air exits through cap above (right). Opposite occurs in winter (left).



A city of tents can be erected quickly after the airdrops land. Saddle-shaped connecting pieces can be zipped between tents at all four sides to form centers of community action, such as first-aid area.



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These imaginative tents —combining aerodynamics with style—are meant to be lived in

By BRYAN HATHORN BERRY

Apply the word "tent" to one of Bill Moss's remarkable structures in his presence, and you may start a debate.

"Not tents," he says, speaking of his airdrop shelter or his latest line, which ranges from the 1000-sq.-ft. Omar to the 350-sq.-ft. O'Dome, and includes Optimum and Quadrillium. "Prestressed membrane structures. Or tension structures. The more tension you put on an ordinary tent, the weaker it becomes. Not so with my designs. Increase the number of layers of the light membranes I use—or the amount of external tension, as from wind—and the structure gets stronger. Also, I use arches in my designs. Compared with poles, they give better distribution of load, more interior space and, again, better resistance to wind. Constructing the fabric is easier, too, since it doesn't require the hand-sewn reinforcement necessary to hold the point of a pole."

Moss, who introduced the fiberglass arch in the '50's, is now using a spring aluminum alloy similar to that found on aircraft (for the Omar), and a combination of the aluminum and glass (Optimum, Quadrillium, O'Dome). "Glass is suitable for smaller tents, since it bends easily and to a small radius. It's also very resilient —more so even than metal."

Sheikh shelter

His latest line was inspired by the desert. The governments of several Middle Eastern countries need temporary housing for construction workers, the military, and for Bedouins they are trying to lure to fixed locations near the cities. The governments —the sheikhs, that is—have other uses for the tents: for weekend trips with their families, and to shelter their parties of up to 100 on falcon-hunting expeditions for as long as three weeks. They turned to Moss.

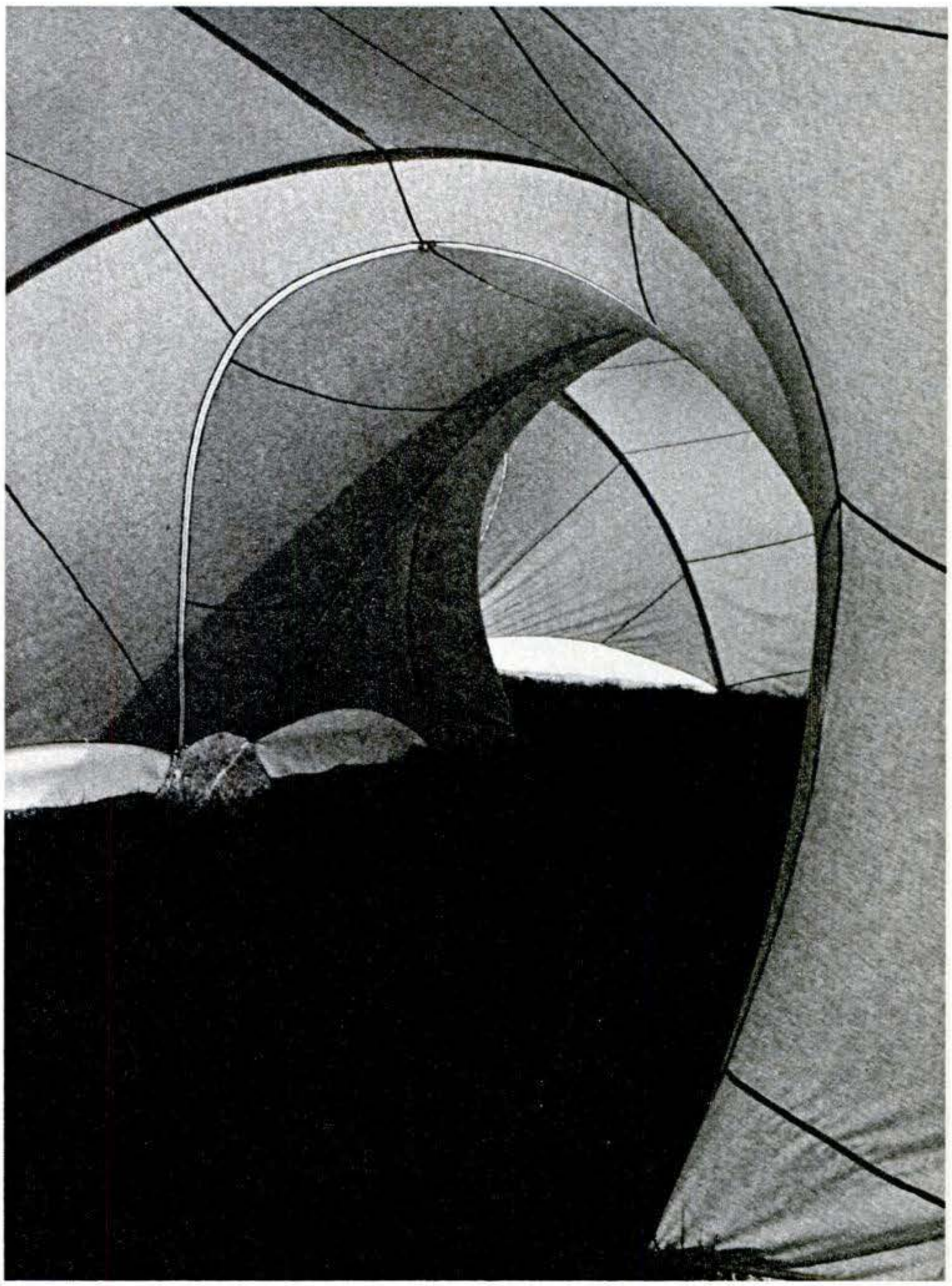
The assignment posed some special challenges: The tents had to withstand winds of up to 100 mph; and achieve an interior temperature acceptable to the Bedouins—85° F under a 120° sun. Moss's Western credentials for the job were good—training in art, engineering, and aerodynamics—but as a Yankee in a sheikhly court, he had to learn the science of Arab tent design. He did.

"Where I've been able to most improve upon the traditional Arab de-

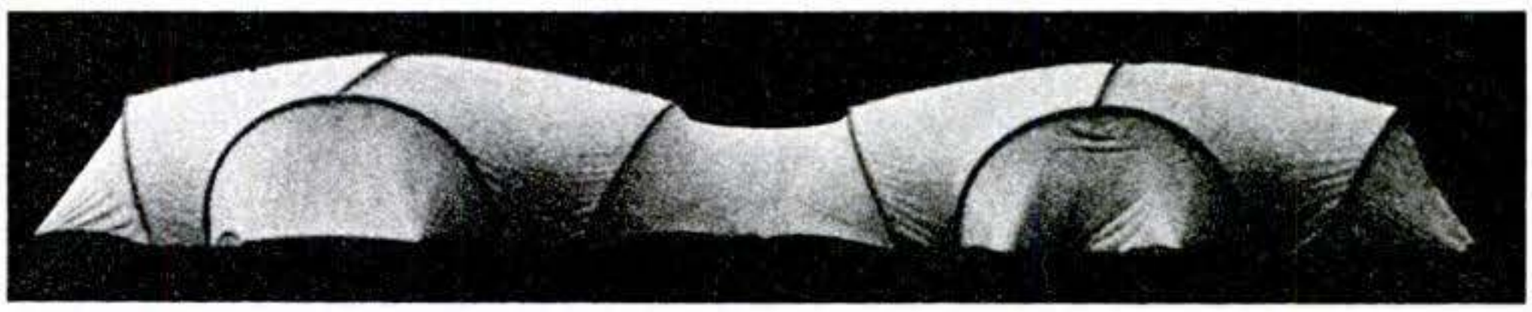
Continued

Airdrop's exterior cap is the pre-chute; tent is the chute. Payload would be attached. The 7½-lb. airdrop lands upright and can be deployed by a single person.

Sheikhs and retinue on extended falconry expeditions are among customers for whom Moss designed 1000-sq.-ft. Omar. Crown prince of Abu Dhabi is at left.



Sleek aerodynamics of Omar make it resistant to 100-mph desert winds. In summer, cool air enters through bottom vents; hot air exits through vents at top.



Triangular connectors between Omars form arched vestibule 6½ ft. high at lowest point. Connectors need no framework and take up slack from tents joined.

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signs has been in the aerodynamics," Moss says. I've increased the airflow through the tents. For summer cooling, cool air enters through the vents at the bottom, and warm air exits through vents at the top. The thermal movements are reversed in winter.

"The Bedouins wouldn't accept any material but cotton, and so that's what I've used. However, I've used two layers of cotton; in some cases, three."

The exterior layer is a cotton-duck fabric; the interior, a cotton sheeting of a lighter weave, which will be available in decorative patterns. By trapping heat, the two layers make the tents warmer in the winter, cooler in the summer—whether in the United Arab Emirates or Tuscaloosa, Ala. The use of two layers for the Optimum and O'Dome—now on the American market—is new to this country.

More than tentative

Moss describes O'Dome and Optimum as "family houses"—not tents. "The word 'tent' implies short-term use. These houses can be constructed on a platform and inhabited for a summer comfortably."

The argument is an appealing one: Why not live, at least part of the year, in such structures?

"I'd like to see a return to the platform tenting that was fashionable in the 1930's among the American wealthy," Moss continues. "In Europe, it's now fashionable to construct tent cities by the sea, complete with brightly colored flags. You *live* in platform tents, you don't camp out."

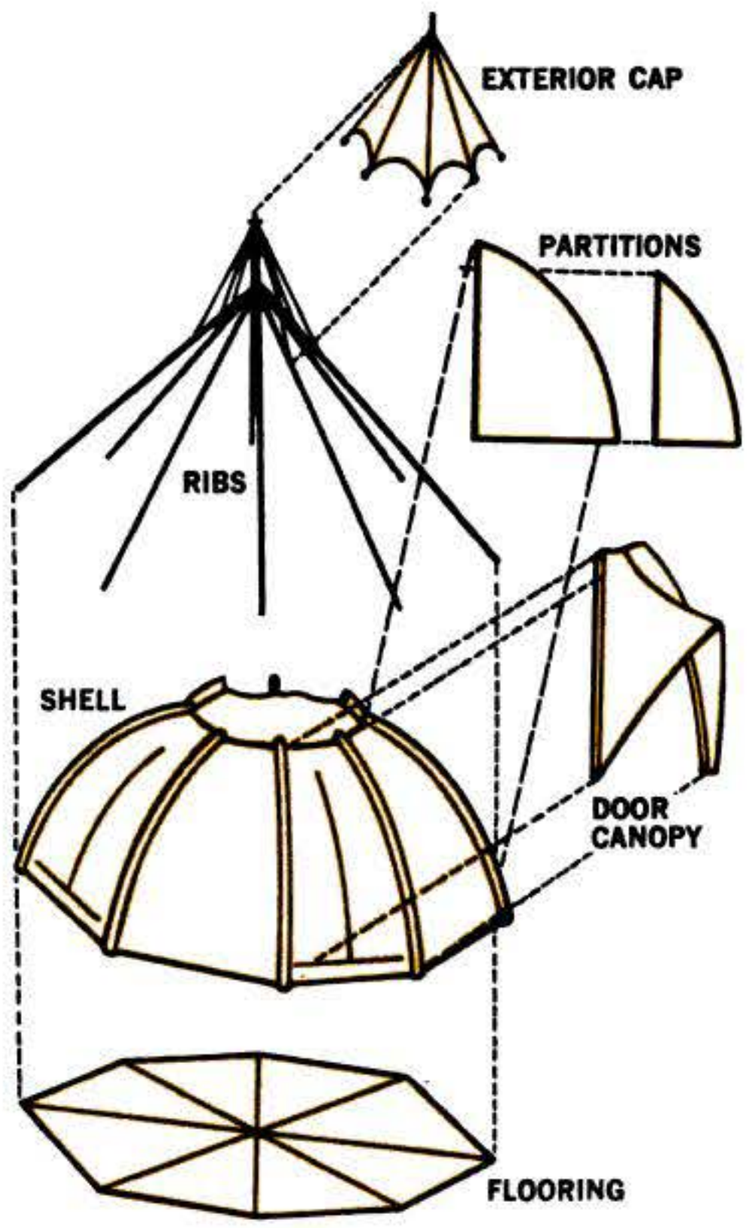
The functional grace of his designs may be one of Moss's best arguments for tent cities. And if you enjoy one of his tents, you can just as well enjoy two, three, or four—and walk through all four in the rain without getting wet. All his current designs can be modular: A connecting piece can be zipped between them at any side to form a linking arched vestibule.

Emergency housing

That modular design is shared by another of Moss's structures with quite a different purpose. Unlike the others, the airdrop shelter is meant for short-term use—after natural disasters, when community life has been disrupted and people are in need of immediate medical attention. Relief operations must be fast, if the numerous deaths immediately after the disaster are to be prevented. Moss's response to the need for short-term housing for disaster victims is the airdrop shelter, a dual-function design that's a payload-bearing parachute by air and modular shelter by land. Its exterior cap (see drawings) is Moss's neat solution to a twofold problem: By air, the cap is a pre-chute; by land, it's a source of diffuse light and part of the ventilation system. Fiberglass ribs create the airdrop's tension and its proven resistance to extremely high winds.

The payloads would be food, water, bedding, medical supplies, and communication equipment. Community centers for communications, first aid, supplies, dining, and mechanics would be created by zipping together the airdrops.

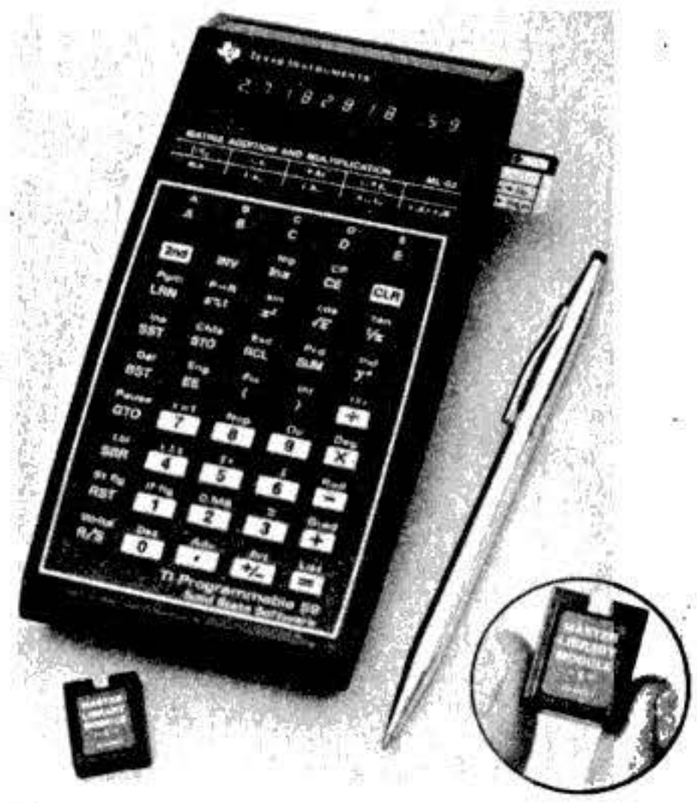
"A disaster tends to break down social order," explains Moss. "The community centers, quickly erected, could help restore it. The individual airdrops are sized to accommodate family units. The first impulse of families in the shock following a disaster is to return to their homes, and that causes more deaths, sometimes simply from exposure. Airdrops would give them a place to shelter privately, as a unit."



Airdrop's ribs create tension at base of shell. Beds fit within seven-ft. panels of shell. Partitions fastened along rib lines to floor give privacy.

Whatever the next project of Bill Moss and his small firm (Tent Works, Camden, Me. 04843) may be, you can expect it to be efficient, simple, and graceful. The Parawing, for example, is a canopy of waterproof cloth or paper for protection against rain or sun. Other structures, such as a 90-foot-high, three-story theater pavilion for 1200, commissioned by the Smithsonian, are designed to accommodate larger assemblies. You might even call them tents. PS

Programmable calculators
use plug-in solid-state memories



Tiny plastic module (inset) plugs into Texas Instruments' model 59 and delivers 5000 program steps, which once required almost 24 magnetic cards.

Two pocket-size programmable calculators from Texas Instruments adapt quickly for various fields—statistics, real estate and investment, aviation, marine navigation, and surveying—when you plug in small solid-state modules containing prewritten programs. Both new programmables, the $125 model 58 and the $300 model 59, include a master-library module, which makes 25 programs available.

T.I.'s plug-in program modules simplify entering the numerous steps often needed to solve problems with programmable calculators. With other hand-held models, this is accomplished with magnetic cards or keystrokes only [PS, Feb.]. The model 59 uses magnetic cards in addition to modules. Programs in the plug-in modules can't be altered, but can be combined with other programs you develop. Both models feature an algebraic operating system, allowing equations to be entered left to right.

The two calculators let you use electronic storage for either program steps or memory. The model 58 has up to 480 steps or up to 60 registers; model 59 has up to 960 steps or up to 100 memory registers. As you add or subtract 10 memories, 80 program steps are added or taken away from storage. This feature is useful for handling short problems with many numbers (budgets, statistics), or long problems with many operations and few variables (stock options or orbital mechanics).

T.I.'s two new models also plug into an optional $200 printer.—*John Free*

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WOOD STAINS

...keys to a fine finish

Simple tips on buying and using stains can help you unlock the beauty of wood

By A. J. HAND

Woodworking craftsmanship doesn't mean a thing if you bury it under a bad finish. Yet in my experience, that's what most home craftsmen do. Much of the damage is done during staining, because few people know how to buy the right stains or how to use them.

Stain makers aggravate the problem. First they bewilder you with a staggering variety of stain types. Then they make some of the best types almost impossible to buy through normal retail channels. You often have to go out of your way—through mail order—to get the best.

If you'd like to improve your staining techniques, you should learn how and where to buy the right stain for the job at hand. Then learn how to use it. It's all fairly simple.

Despite the variety of stains on the market, there are only two basic ways to stain wood. One is to coat the wood with a thin film of opaque pigment. The other is to color it with a dye dissolved in a solvent such as oil or water. In most cases the pigmented stains are the easiest to find and the easiest to use. The dye stains

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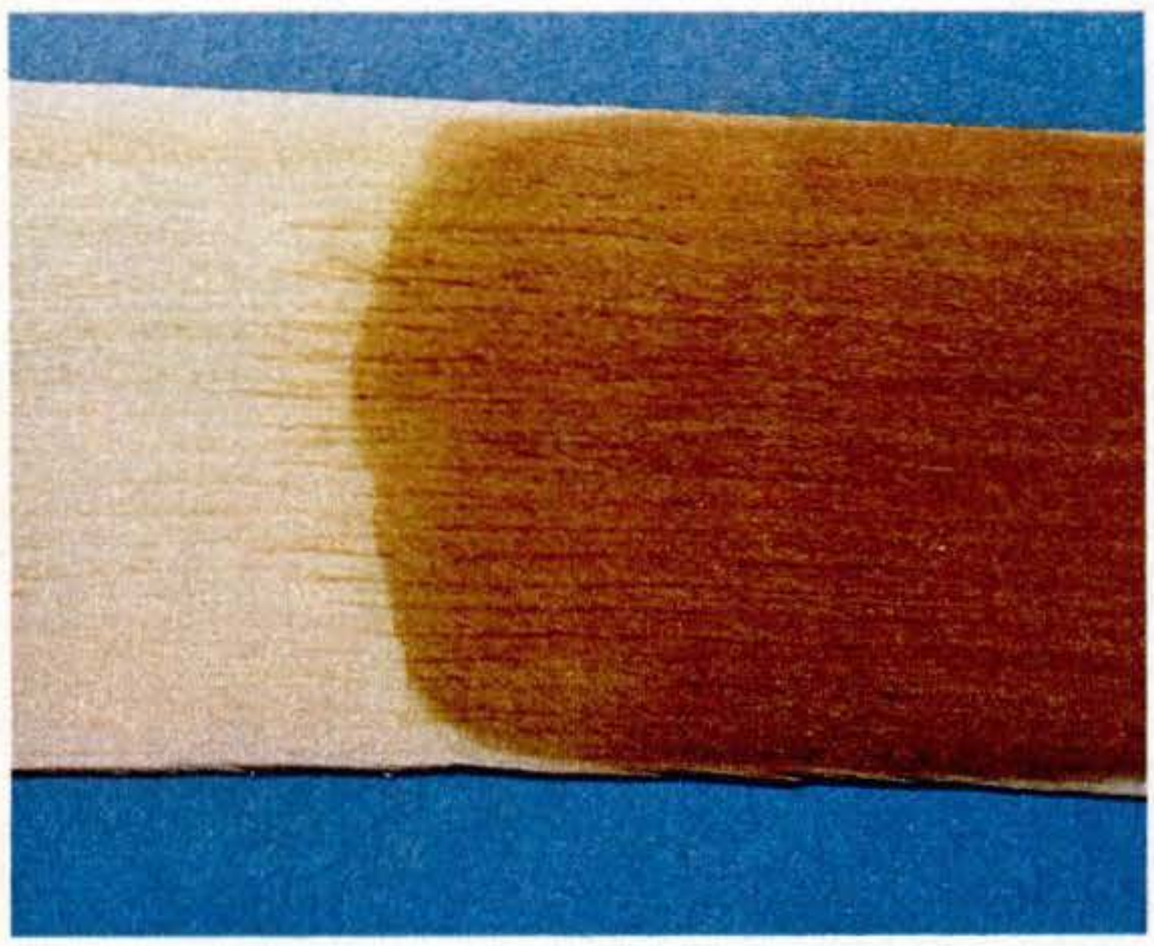
Wood stains come in a staggering variety of colors and types. Picking the right one is critical for the best results.



Common chemicals can give good results when used as stains. Above are white oak treated with washing soda, and pine stained with potassium permanganate, available in crystal form at drug stores and well-stocked camera stores.

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are much harder to find, and a little more difficult to use. But they give better results in a wider range of situations. Let's take a closer look at both types.

Pigmented stains

These are the most popular type around. One reason for this: If you go into a paint store, better than nine out of 10 cans of stain on the shelves will be pigmented stains; there's little else to choose.

But there's another reason. Pigmented stains—or pigmented wiping stains—are very easy to use. That's why they were developed. You can slop them on any old way, let them set a while, then wipe them off. The result is even coverage.

But you get this even coverage at a price: The thin film of pigment left behind does more than color the

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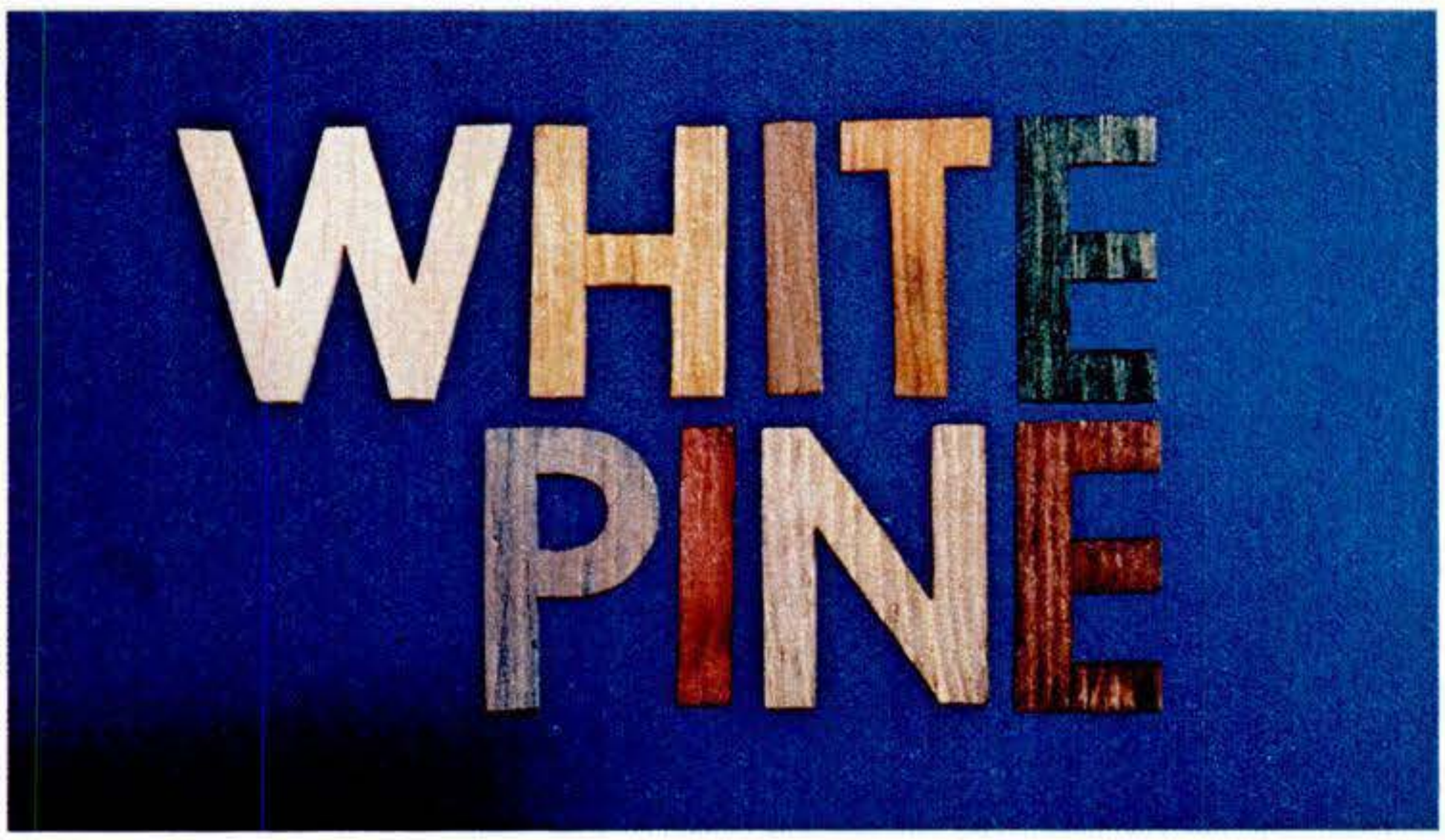
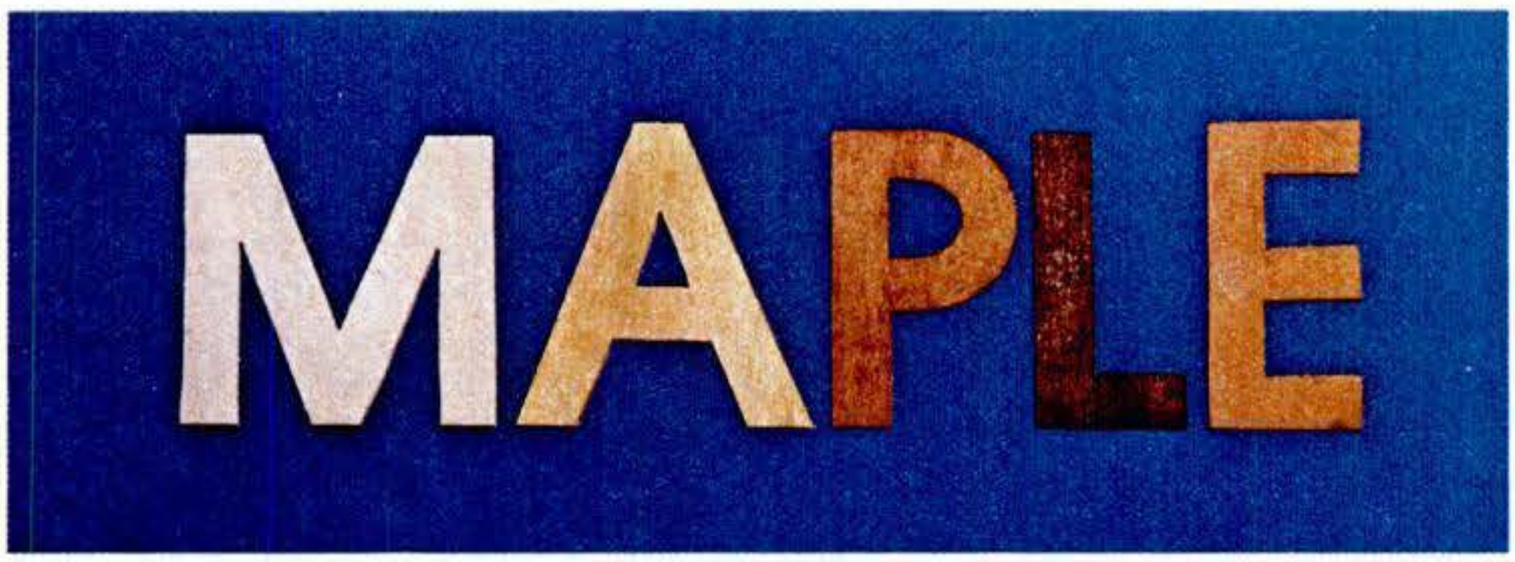
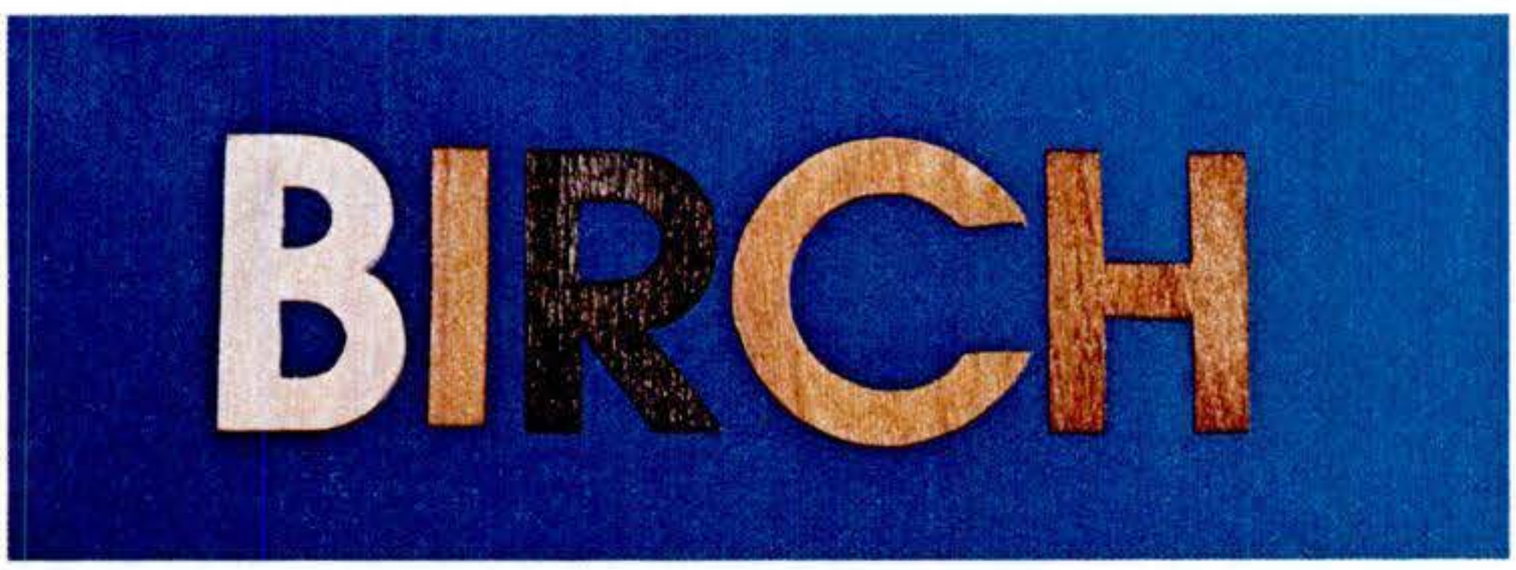


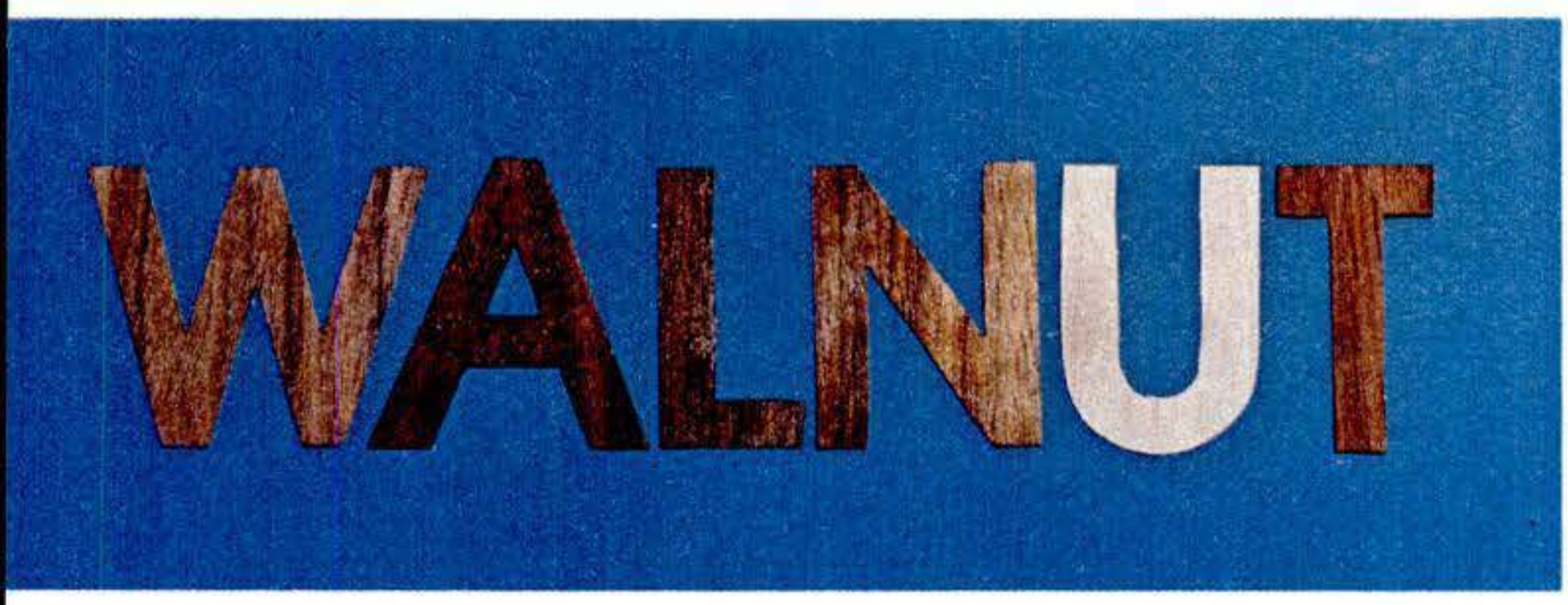
White pine, stained, looked like this: W, no stain; H, Minwax Puritan Pine; I, vinegar stain; T, golden-amber maple water stain; E, Rez Ponderosa Pine oil stain; P, Rez New Spruce; I, red-mahogany water stain; N, Minwax Early American; E, brown-mahogany water stain.



Sugar maple, stained, gave these results: M, no stain; A, Minwax Colonial Maple oil-based dye and pigment stain; P, yellow-maple water stain, half-strength; L, brown-mahogany water stain, half strength; E, golden-amber water stain.



Birch was stained as follows: B, no stain; I, golden-amber maple water stain; R, walnut NGR stain; C, Benjamin Moore Benwood Colonial Maple pigment stain; H, yellow-maple water stain, half-strength. Birch plywood will stain to look like many other woods.



Walnut needs little staining to look its best. Here are: W, no stain; A, brown-mahogany water stain, half-strength; L, brown-mahogany NGR; N, Tungseal 921 maple dye-type oil stain; U, bleach; T, yellow-maple water stain, half-strength.

African mahogany treated with a variety of stains gave these results: M, no stain; A, mahogany water stain, half strength; H, mahogany water stain; O, mahogany NGR; G, red-mahogany water stain; A, red-mahogany NGR; N, Tungseal Maple; Y, Rez Cherry oil stain.

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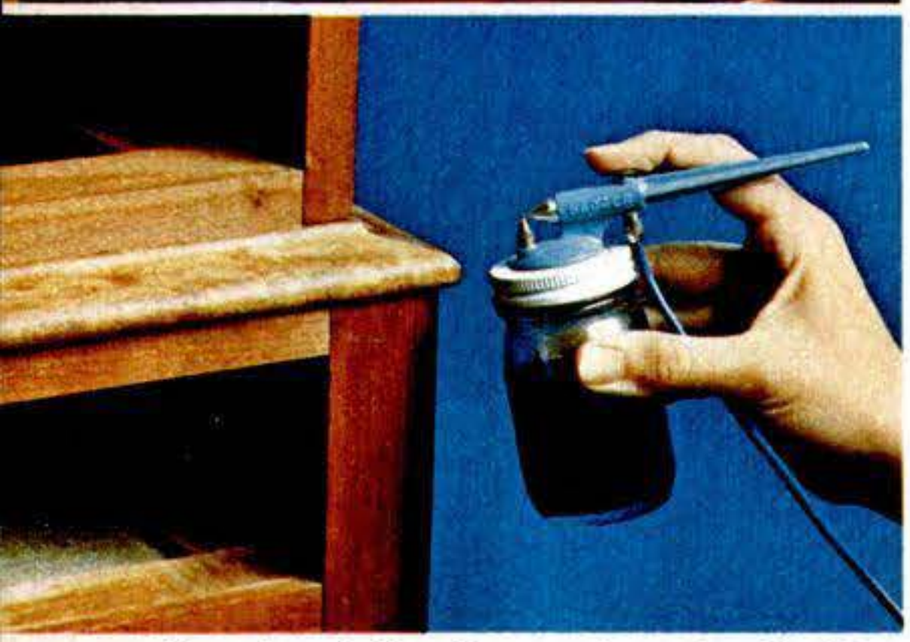


Powdered blending stains mixed with a padding lacquer (top) are best used for repairing damage in existing finishes. A small hobby airbrush is handy for blending. Here it's used to darken a piece of bad wood in a kit-built secretary.

Always make a test before staining, and include a coat of varnish over each of the stains for best results. Naturally, use the same wood you will use for the finished piece. Here are progressively diluted water stains.

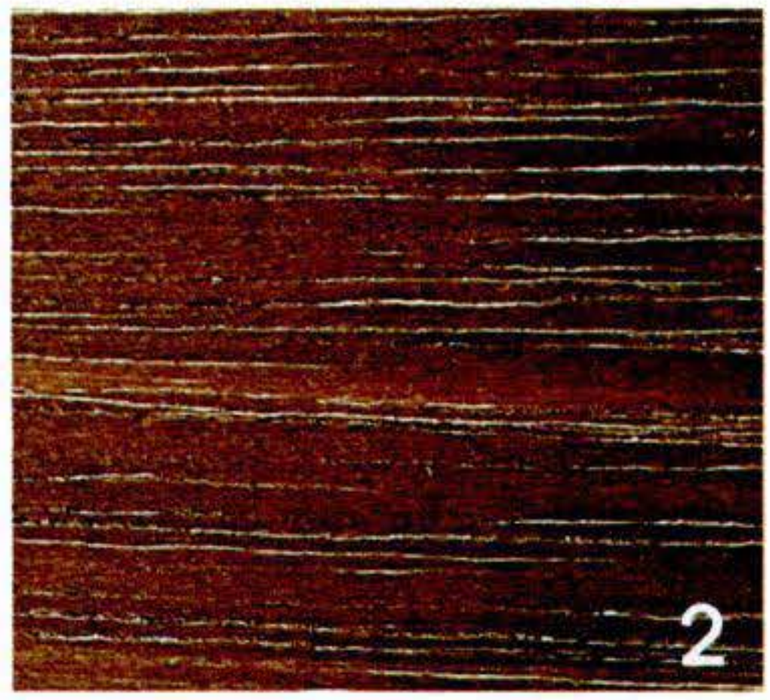
wood. It also masks it to a degree. Like a light haze, it hides the detail in the grain, dulls the fire in the wood, and reduces its depth.

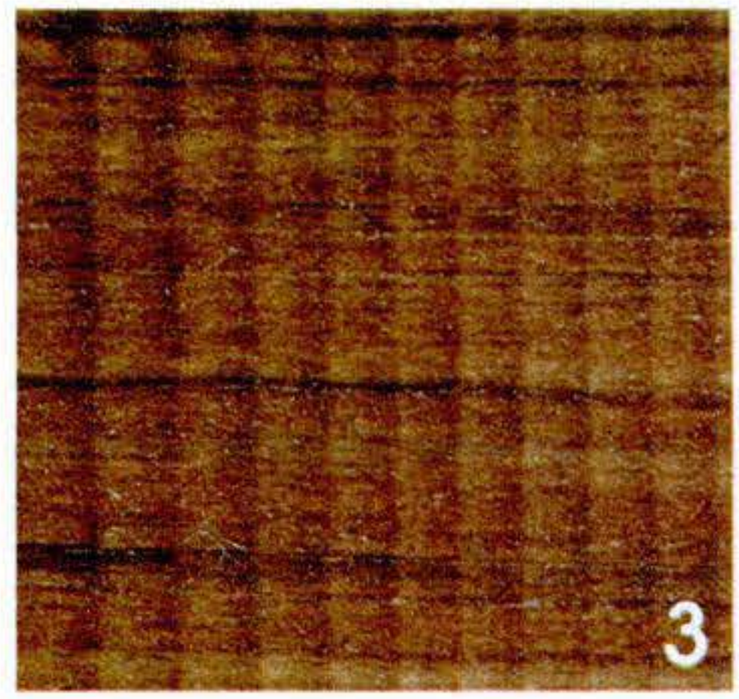
Admittedly this dulling effect is subtle. But it is real enough to deter you from using a pigment stain on anything made of fine hardwood. There's just no sense in downplaying the beauty in a fine piece of curly maple or striped mahogany just to get ease of application.

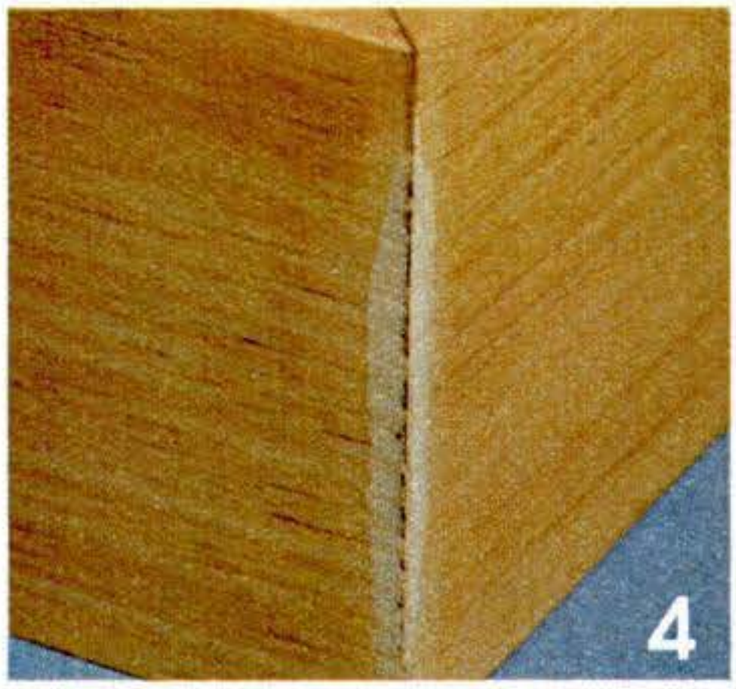
Another problem with pigment stains: The pigments tend to collect most in blemishes and poorly sanded areas. This puts a premium on careful preparation of the wood. Poor preparation will result in a splotchy effect with smoother areas lighter than the rougher areas, and blemishes standing out against a lighter background.

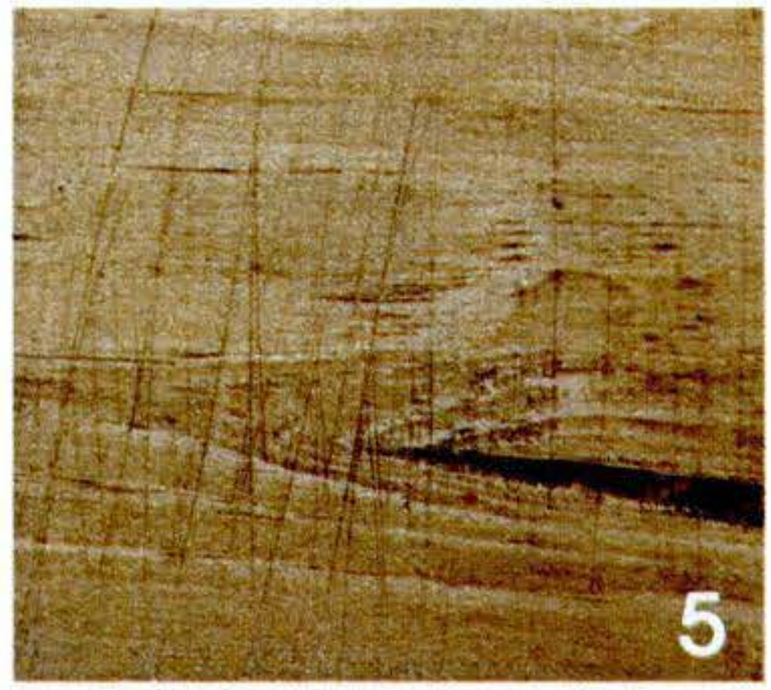
But pigmented wiping stains do a good job on softwoods such as pine. And their tendency to collect in blem-

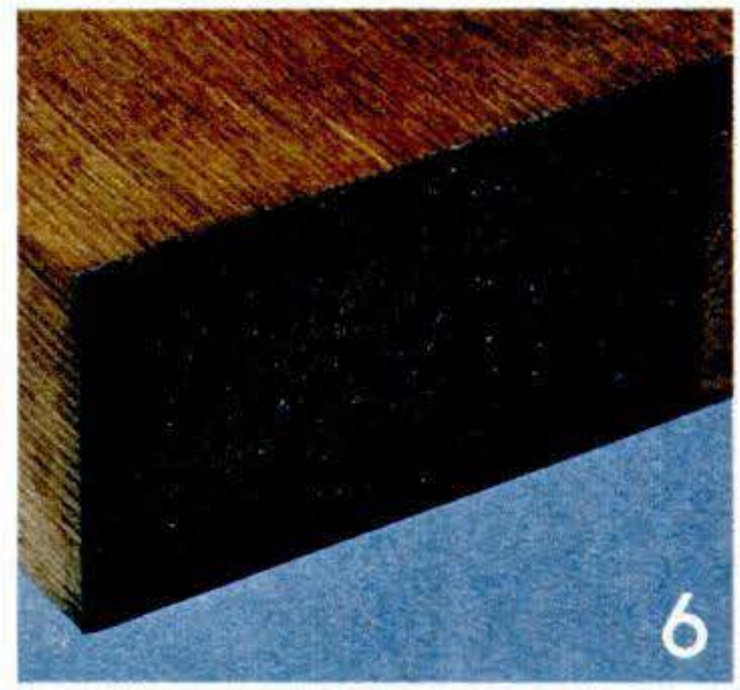
Can you identify these common stain errors?











Common mistakes are shown here. Curlicue marks were left by coarse paper in an orbital sander (1). Water stain was not forced into the pores of the mahogany (2). Jointer marks were not sanded out before staining (3). Excess glue oozed out of this miter joint (4) to prevent absorption of the stain. Sanding across the grain created these unsightly scratches (5). Sand *with* the grain. End grain on piece of pine (6) was not sealed, so it stained much darker. To avoid this, seal end grain before staining, using the same material you'll use for top coats. Dilute it with four parts thinner.

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ishes makes them ideal for distressed-look furniture. So you might want to use one on a piece of Early American pine furniture, to give it an aged and use-worn look.

Pigmented stains are ideal in large-area applications, as well—on floors or pine paneling, for example. Here ease of application is vital. The pigmented stains will go without a lap mark. And since floors and paneling don't invite close scrutiny as furniture does, any slight masking of the wood's beauty will go unnoticed.

How do you tell the difference between a pigmented stain and a dye stain? First of all, if the stain comes in a can, and it is readily available at a paint store, it probably contains pigment. To be sure, check the ingredients on the label. Study the largest can size available: Often you'll find more information on the large cans than on the half pints.

If you find an ingredients list, look for the word "pigment." If it's there, you have a pigmented stain. Other tip-off words are silica and silicates—opaque solids, in other words.

Pay no attention to the vehicle listed in the ingredients. Whether a pigment stain is a latex, an oil, or any other type makes little difference. All pigmented stains give fairly much the same results, no matter how they are thinned.

No ingredients list? Do the instructions tell you to stir the stain thoroughly before using? That's a sure sign there are solid pigments in that can. If all else fails, pop the can open and look inside. Does the mixture look cloudy or opaque? More like mud than tea or coffee? Then it is pigmented.

Note: Some stains—Minwax, for example—contain both dyes and pigments. If you want a stain with clarity and brilliance, don't stir the solids up. But if you want the solids —to accentuate distress marks, or to get a slightly darker tone—go ahead and stir.

Dye stains

These come in a variety of types. Basically they are soluble dyes, and are usually sold in powder form. One type dissolves in water, another in oil and lacquer solvents, a third in alcohol. A fourth type, sold already mixed in a special solvent, is called non-grain-raising, or NGR.

By far, the most useful of all of these is the type you get in powder form and dissolve in water. These water stains have a lot of advantages.

- They are inexpensive. A pack of powder for about 70 cents will make a quart of stock solution. In use, you may dilute this solution, so in effect you can get a gallon or more for less than a buck.
- It penetrates deep into the wood, locks into the fibers, and won't fade.
- It is compatible with any finish you put over it.
- It is crystal-clear, so it colors without obscuring.
- It is easy to custom-mix. Dilute it with water to get just the right shade. Or blend two or more colors to get just the right hue.
- It is easy to clean off your brush by just rinsing in water.

If this stuff is so good, why is it so hard to find in stores? Probably because it takes a little more work to apply it. Whenever you wet freshly sanded wood with water, tiny whiskers of wood will stand up, leaving a fuzzy surface. The same thing happens when you brush on a coat of water stain.

> "It's not very common for the cheapest to be the best, but in this case it's true"

To solve the problem, you raise the grain on purpose before staining, then lightly sand the whiskers away. The usual procedure is to sponge the carefully sanded wood with warm water to raise the grain. Let the wood dry, then sand very lightly with 220 paper—only enough to remove the fuzz. Now you can use the water stain with no problem; the fibers will not rise again.

Applying water stain is easy enough. The idea is to flood the surface of your work with a good wet coat of stain. Use a fairly stiff nylon brush as large as is practical for the size of your work—so you can force the stain into the pores of the wood. Keep the brush wet at all times, avoiding the temptation to stretch the stain out, but be careful not to splash stain ahead of yourself.

That's about it. It's not very common for the cheapest to be the best, but in this case it's true. There is, however, one weakness in water stains: They are no good for refinishing. Even if you are very careful about removing the old finish, some of it will remain behind in the wood. There, it will interfere with the penetration of the water stain. So for refinishing, use one of the other dye stains, either NGR or oil type.

NGR stains

Like water stains, NGR's are clear dyes, but they are dissolved in a special solvent that won't raise the grain. Though they are not as cheap as water stains, they have most of the other advantages. But you'll find them a little trickier to apply. The additional step of raising the grain is eliminated, but now you have a new problem: These stains dry faster, so you have to work quickly and smoothly to avoid lap marks and unevenness.

That's why you should use water stains whenever possible, saving the NGR's for refinishing. The NGR's are ideal for this kind of work because they penetrate so vigorously. A bit of the old finish left in the wood won't get in the way of an NGR.

Application techniques are the same as for water. Work as rapidly as possible—a big brush helps—and keep the brush wet. If you apply the stain too thin, it will dry too fast, and drying too fast leaves lap marks.

Start each fresh brushful a few inches away from where the last one left off. Use long strokes, and don't go back to fuss over areas already stained—you'll make them darker.

Most NGR stains are very dark when used full-strength, so buy some thinner when you buy the stain. Figure on at least a quart of thinner per quart of stain. Even more thinner won't hurt, but you can thin most NGR stains with alcohol in a pinch.

Alcohol stains

Stay away from these: They dry too fast to be evenly applied with a brush. Even the pros use spray guns when they work with alcohol stains. With water and NGR stains in your shop, you don't need alcohol types.

Oil-type dye stains

Also a powdered dye, this one dissolves in turpentine, naphtha, or —ideally—benzol. Some will also dissolve in lacquer thinner. While you might use some of these powders dissolved in varnish for special shading or toning application, I don't see much use for them in the home shop. They offer no advantages over water or NGR stains, and they have a number of shortcomings: They dry slowly, often forcing you to wait 24 hours before you can resume finishing. Some of them present compatibility problems with

[Continued on page 196]

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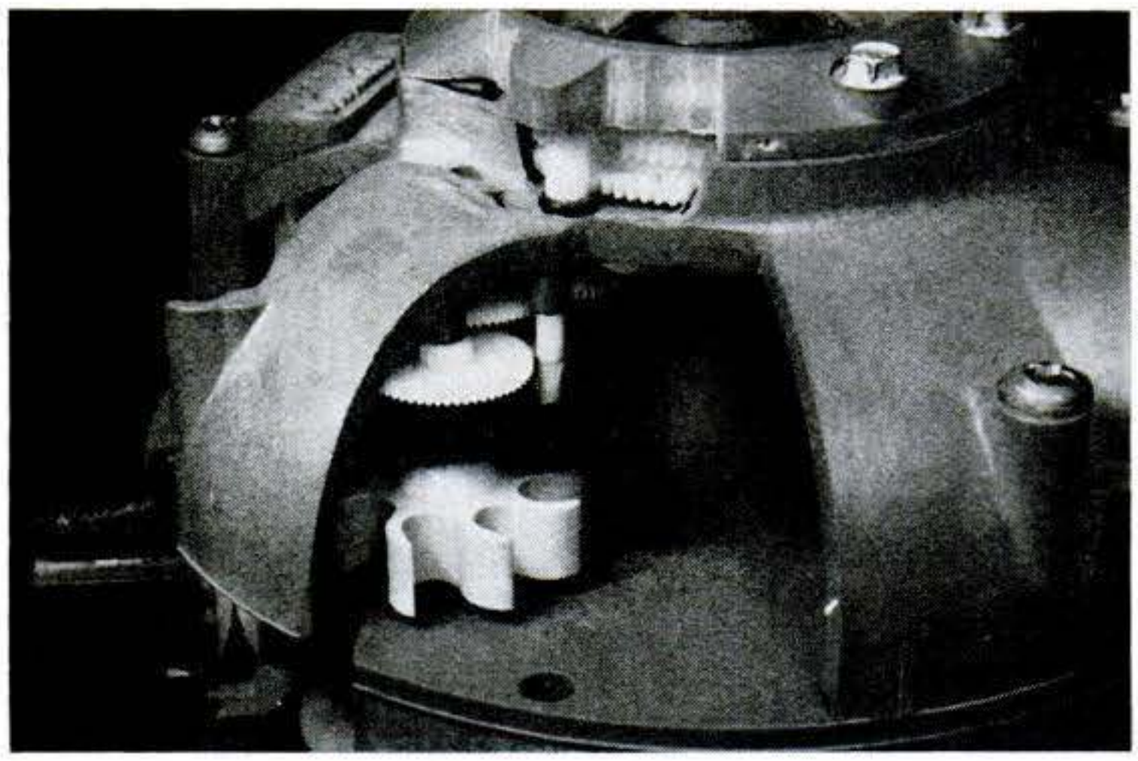
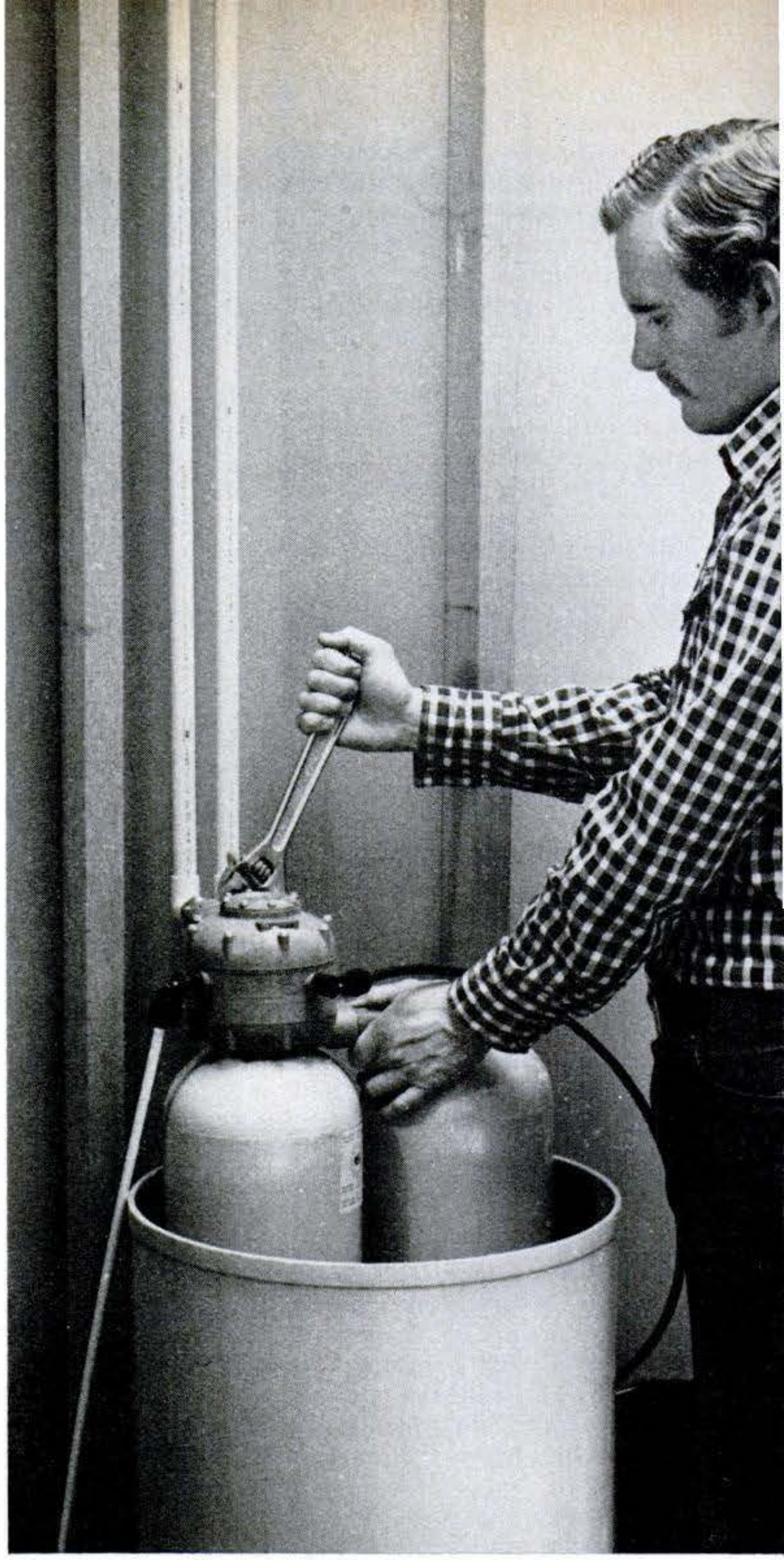
Twin-turbine softener

knows when to regenerate



Water-use turbine drives water-meter disk's gear teeth (top cutaway) through a 40,000:1 gear reduction to kick off each regeneration cycle. During and after each regeneration, it continues to monitor water use.

Twin-tank, twin-turbine Kinetico Water Conditioner comes calibrated to suit a water analysis. Softener tanks of smaller models fit inside salt-storage bin. Regenerations are governed by water use, not by periods of time as in most automatic water softeners.



New water-powered unit always has soft water on tap—without electricity

By RICHARD DAY

Meet a fully automatic water softener that saves water by regenerating only when needed. Unlike time-controlled softeners, it delays regeneration when little water is used and brings it on sooner when much is used. And, unlike sensor-controlled softeners, this water-controlled unit needs no electricity.

What's regeneration? Water softeners remove calcium and magnesium ions from hard water by running it through a resin bed that contains sodium ions (salt). In a chemical process the hardness ions are exchanged for softer, soap-compatible sodium ions. Periodically, the calcium and magnesium ions must be flushed from the resin bed; this is the regeneration cycle. (In December's issue, I'll describe in detail how water softeners work, plus how to install one yourself.)

Called Kinetico, this new water softener uses the kinetic energy of flowing water to gauge how much water you use. Then, when the softening capacity in one of its two tanks has been depleted, it switches that tank off-line and switches a fresh tank on-line. You're never without soft water. The off-line tank is regenerated automatically.

Increased water use by house guests cannot fool the system. Neither can decreased use during vacations. Cut down on your water use and the softener cuts down on regenerations. Salt savings of as much as 50 percent are claimed. Furthermore, during the regeneration, only the amount of water necessary to do the job flows through the unit.

How does the Kinetico work?

I won't say it's simple—ingenious would be closer to the truth. The unit's controls are housed in a six-section labyrinthine fiberglass control module to which both tanks are attached. The module's system of inner passages would make an automobile carburetor blush. Water, diverted past a water-use turbine, shoots at the turbine's

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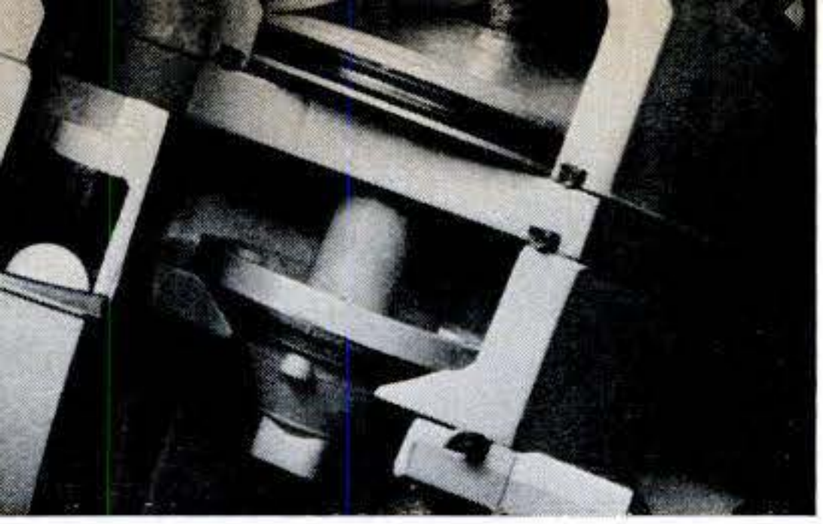
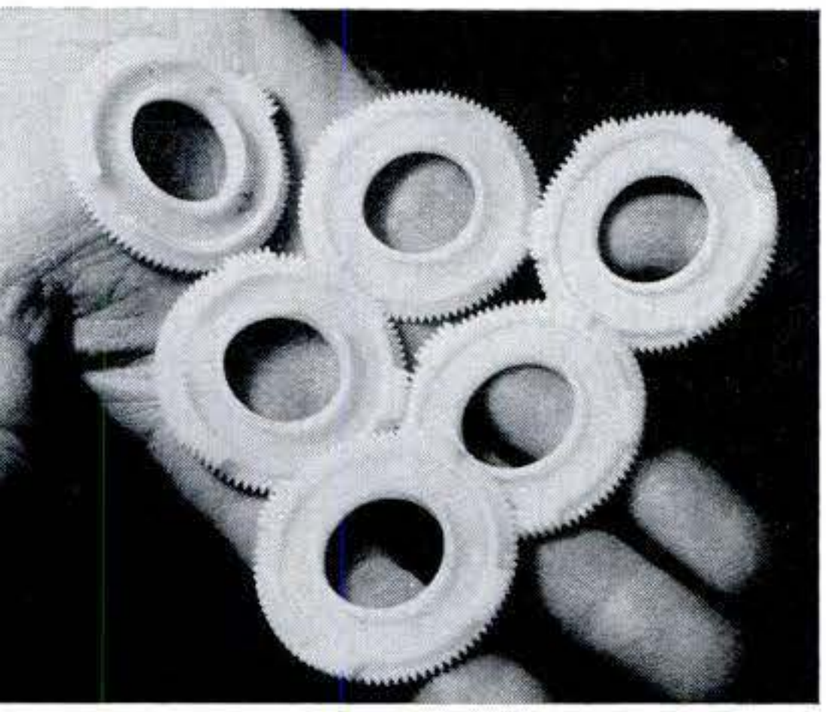


One of seven servo valves and pistons in control module: These turn on, turn off, reroute, and divert water.



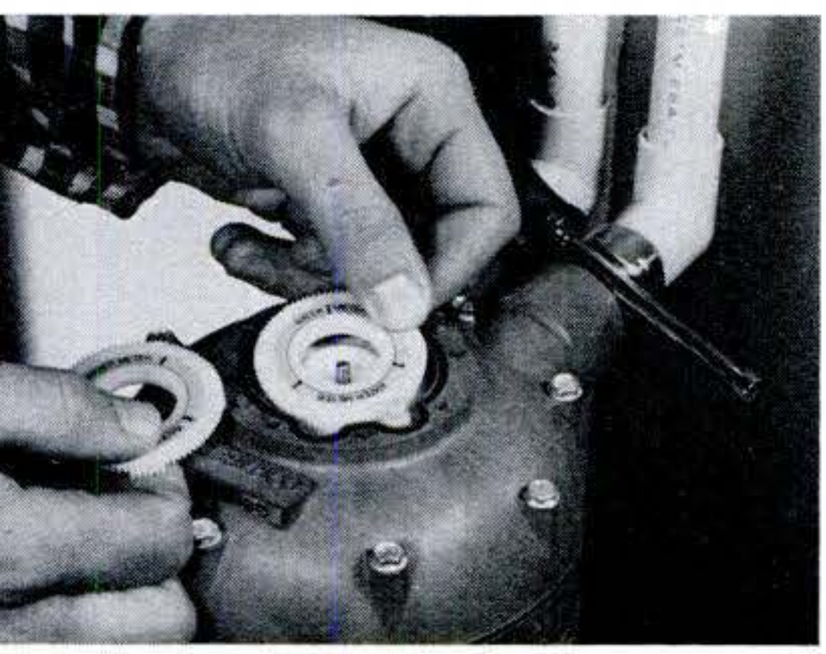
Water-meter disks come with from one to six wide spots around their perimeter gear teeth. These mesh with an idler gear to initiate each brine/rinse/backwash cycle. Disks are numbered from 1 to 6 for softest to hardest water, corresponding to their wide spots.

Hydraulic-control programming of Kinetico softener

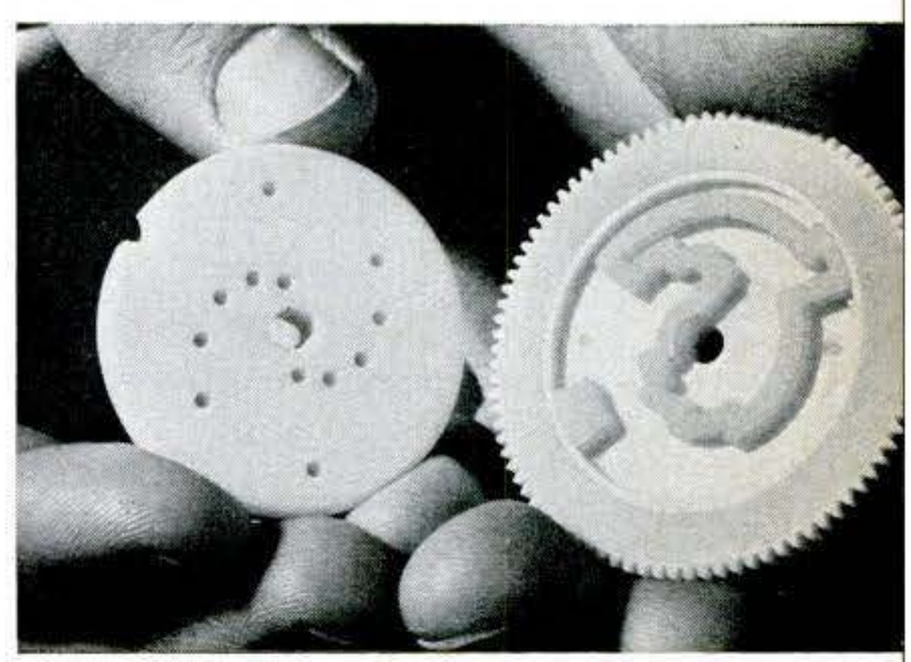
PROGRAMMED ACTION		VALVE POSITION*					
		Master-control valve	Tank no. 1			Tank no. 2		
	Step No.		Inlet valve	Outlet valve	Drain valve	Inlet valve	Outlet valve	Drain valve
TANK NO. 1 REGENERATES	1. Tank 1 on-line in service; tank 2 off-line ready	Closed	Open	Open	Closed	Closed	Open	Closed
	2. Regeneration starts on No. 1 tank	**Open**	Open	Open	Closed	Closed	Open	Closed
	3. Tank 2 placed in parallel service with No. 1	Open	Open	Open	Closed	**Open**	Open	Closed
	4. Tank 1 taken off-line	Open	**Closed**	Open	Closed	Open	Open	Closed
	5. Backpressure to tank 1 through its outlet valve is cut off	Open	Closed	**Closed**	Closed	Open	Open	Closed
	6. Brine aspirated into tank 1 until brine container is empty, then soft-water rinse continues	Open	Closed	Closed	**Open**	Open	Open	Closed
	7. Rapid backwash rinse with soft water	Open	Closed	**Open**	Open	Open	Open	Closed
	8. Regenerated tank 1 put on hold	Open	Closed	Open	**Closed**	Open	Open	Closed
	9. Flow to regeneration turbine stopped to end regeneration cycle; tank 2 is on-line; tank 1 is off-line ready	**Closed**	Closed	Open	Closed	Open	Open	Closed
TANK NO. 2 REGENERATES	10. Regeneration starts on No. 2 tank	**Open**	Closed	Open	Closed	Open	Open	Closed
	11. Tank 1 placed in parallel service with 2	Open	**Open**	Open	Closed	Open	Open	Closed
	12. Tank 2 taken off-line	Open	Open	Open	Closed	**Closed**	Open	Closed
	13. Backpressure to tank 2 is cut off	Open	Open	Open	Closed	Closed	**Closed**	Closed
	14. Brining/rinse of tank 2	Open	Open	Open	Closed	Closed	Closed	**Open**
	15. Backwash of tank 2	Open	Open	Open	Closed	Closed	**Open**	Open
	16. Regenerated tank 2 on hold	Open	Open	Open	Closed	Closed	Open	**Closed**
	17. Flow to regeneration turbine is stopped to end cycle; tank 1 on-line; tank 2 off-line ready	**Closed**	Open	Open	Closed	Closed	Open	Closed

*Boldface in body of table indicates active valve.

To change a water-meter disk (seldom, if ever, required), you remove top of control module containing a see-through window. Then you lift off the old water-meter disk and replace it with another. Top of disk shows through window to indicate softener cycling.



Mating faces of ceramic disk and regeneration control gear (far right) are lapped flat to about 11-millionths of an inch to prevent leakage of pressurized water. Portholes in disk are linked to servo valve pistons. One gear recess is pressurized; other is for drainage.



reaction-type blades through an orifice, making the turbine spin. Through a clock-like system of reduction gears, the water-use turbine starts each regeneration cycle.

A second turbine, for regeneration, monitors water used for brining, rinsing, and backwashing of the off-line tank's resin bed. Through a 13,000:1 reduction gearing, this turbine whirs off the various phases of the regeneration cycle, controlling the length of each.

The system, which is patented, combines the skills of a watchmaker with those of a hydraulic engineer.

Although small, the Kinetico conditioner has a phenomenal capacity. Model 30, the smallest unit the firm makes, can remove up to 8000 grains of water hardness an hour, continuously. That's 7680 gallons of water a day at 25-grain-per-gallon (gpg) hardness. How? The softener knows when to regenerate without waiting for an electric timer to tell it. And it holds a freshly regenerated tank on standby, ready to keep the soft water coming. Model 30's capacity per cycle is 6200 grains, which uses two pounds of softener salt. This model is suited to water with hardness to 30 gpg. Other models can handle harder water.

But the real story is what happens while the turbines turn. Inside Kinetico's control module, along with the turbines, are seven water-controlled servo valves. These turn on, turn off, reroute, and divert water where and when it's needed. Each softener tank has an inlet valve, outlet valve, and drain valve. And there's one master control valve. Servo valve pistons connect through internal passages to a tiny port critically positioned in a ceramic disk. Stationary, the ceramic disk's flat-lapped surface mates with a similarly lapped surface on a regeneration control gear that rotates above it. Pressurized water around the two cannot leak in. Instead, control water must flow where it's directed.

To direct it, there are two shaped recesses on the gear's bottom (see photo). One recess is pressurized with soft water; the other functions at ambient pressure and leads to a drain. When the port leading to the

[Continued on page 194]

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Fall Home Value Ideas

Beginning here: a special section for DIY homeowners

Owning your own home can prove a financial burden, with costs on an ever-upward spiral. One way to cut the cost is to improve and repair your home yourself. You'll find an ally at your local hardware store or home center. They've got the products, the how-to displays, and often the expertise to help you. This PS special section—tagged with the autumn-leaf symbol—spotlights some of the tools and materials you'll find there.

Scroll saws

can they take the place of saber, hand, radial-arm, and table?

By THOMAS H. JONES

What can you do with a scroll saw that you can't do with other saws?

For one thing, with a scroll saw (sometimes called a jigsaw) you will be able to do all the curved and intricate sawing you would like to be able to do with a saber saw (sometimes also called a jigsaw), but can't.

Besides being able to follow any devious line you can draw, a scroll saw can rip and crosscut. I use mine regularly for cutting two-by framing lumber, and hardwood just as thick, and for all general cutting.

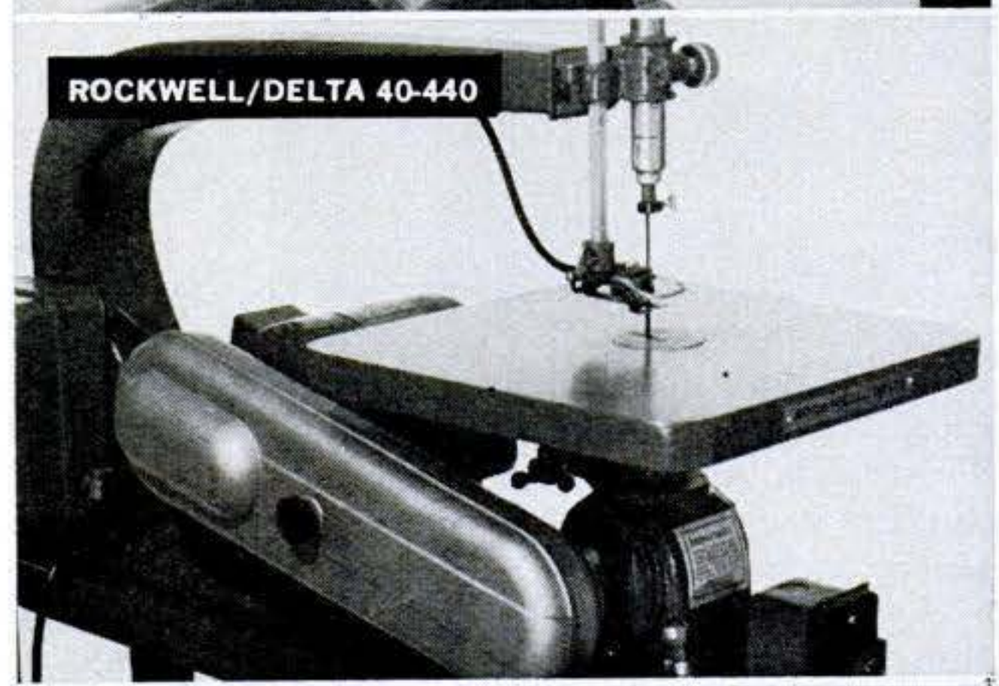
Why? Because it's faster—not faster in the sense of the blade speed through wood, but overall, measured from the time you decide where you want to make the cut, until the cut is finished. As an example, you can saw complete tenons faster than you

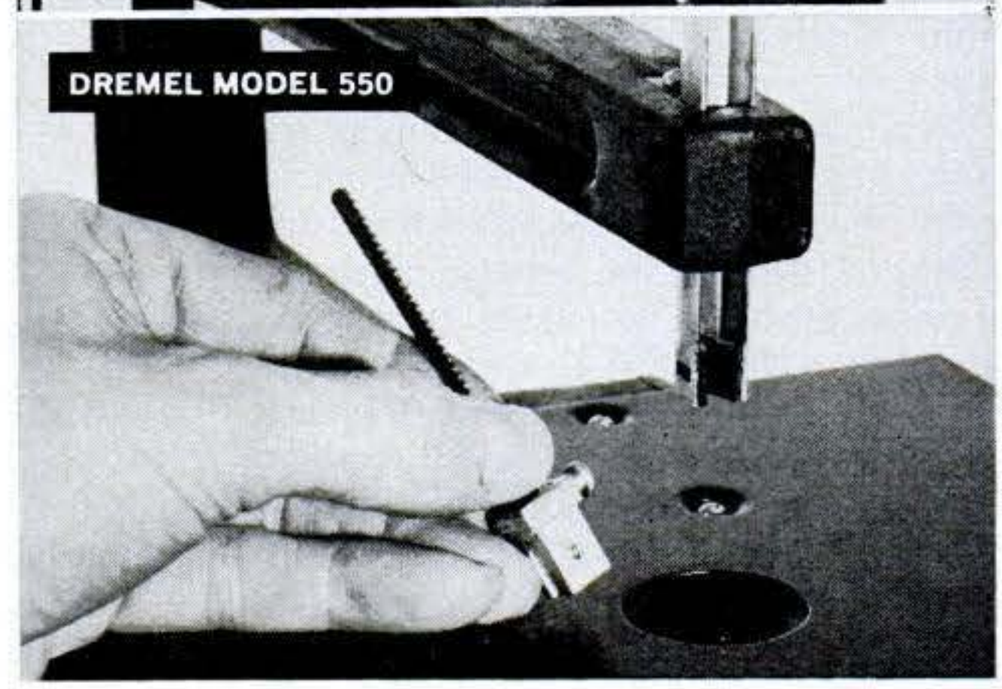
Continued

DREMEL MODEL 571

SHOPMASTER J2000

SPRUNGER J200


ROCKWELL/DELTA 40-440


DREMEL MODEL 550

Dremel Model 571 Moto-Shop: A little saw, with ambitious bite, it has capacity for 1½" softwood with blade guard removed. Cutting is slow and you must support long pieces so saw doesn't tip over. Ideal for crafts, model building, and light shop work, it has a 15" throat. **Shopmaster J2000:** Sawing tenons on a scroll saw such as this is fast, accurate operation. The J2000, shown with optional motor and stand, has 20" throat, can cut 2" hardwood. **Sprunger J200:** All scroll saws can do intricate cutting in thin wood and veneer; larger scrolls such as the Sprunger can do the same in hardwood and plastics up to 1¾" thick, and in metal up to ½" thick. The J200, with a 20" throat, has cast-iron frame. Motor must be mounted below bench top. **Rockwell/Delta 40-440:** This scroll saw has a 24" throat. It's shown with optional stand, magnetic control, motor, and variable-speed drive. The 40-440's overarm can be removed to permit sawing material of any size with saber blade. **Dremel Model 550 Moto-Saw:** Tool is technically not a scroll saw since blade is not clamped under tension between jaws; it's an inverted table-mounted saber saw with a guide to control deflection of free blade end. The 550 has a 12" throat.

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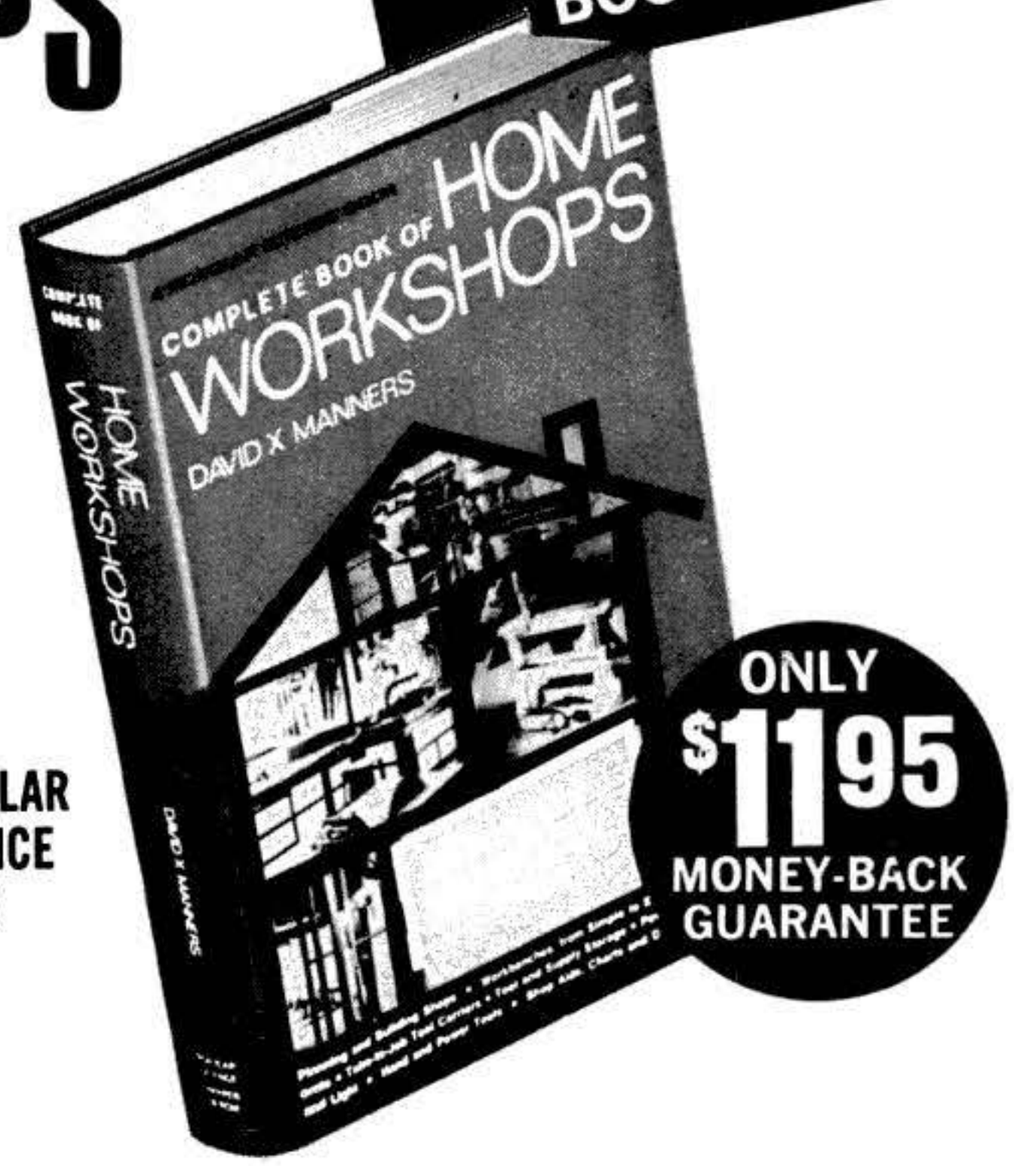
by David X. Manners



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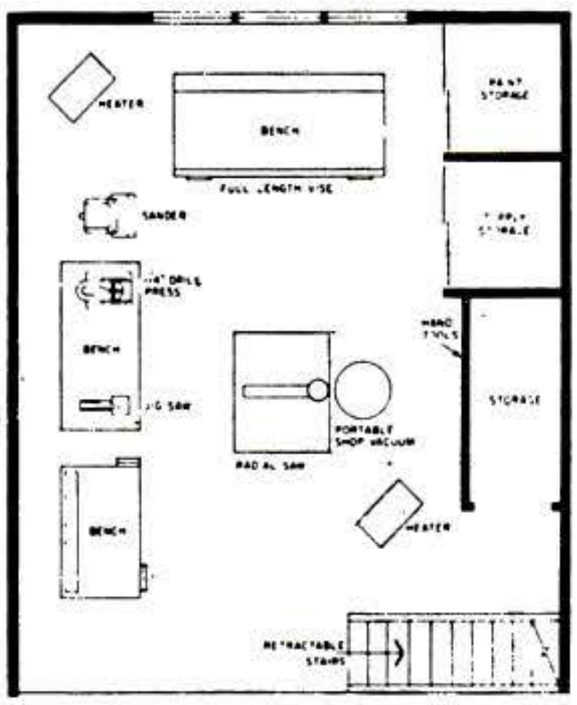
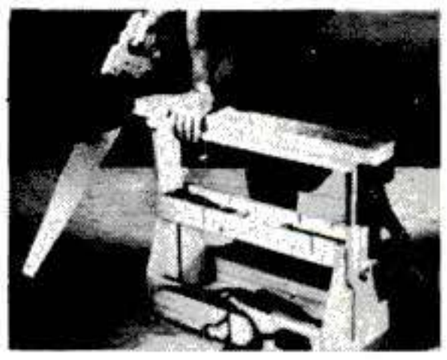
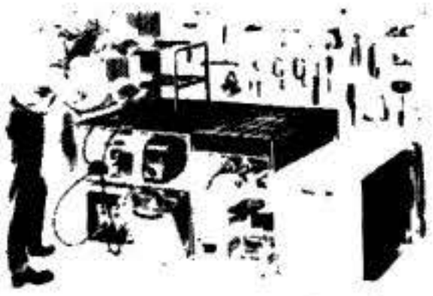


Floor plans like this make it simple to design a shop for any room in your home.



Portable shops range from leather holsters to this traveling assistant you can build yourself.



Bench for metal shop has three kinds of surfaces.

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SCROLL SAWS	Price	CAPACITY: Softwood	Hardwood, plastics	Soft metal	Exotic materials	Throat	Speed cutting, strokes/minute	Motor size	TABLE: Size	Tilt left	Tilt right	Tilt front	BLADES: Length (in.)	Variety	Shipping wt. (lbs.)
Dremel															
550 Moto-Saw	$ 39.95	1½	¾	—	—	12	3450	—	8¼x8½	No	No	No	3	Course, fine	9
571 Moto-Shop[1] (also sold by Sears, Wards)	59.95	1½	—	¼	—	15	3450		8x9½	0-45°	0-45°	0-45°	3	Course, fine	16
Shopmaster															
J20B, without stand	121.50	2	—	—	—	20	—	1/15 hp	10x12	No	0-45°	No	5	Full selection	37
J20, with stand	156.50														
J2000B, without stand	193.00	2	2	—	Note	20	1280	⅓ hp	10x12	No	0-45°	No	5		57
J2000, with stand	225.00														
Sprunger															
J200, saw only	129.17	2	2	½	Note	20	1280	⅓ hp	12x12	0-30°	0-45°	No	5	Full selection	60
J200, saw, motor, stand	210.53														
Powermatic Model 95[2]															
Four speed, saw only	395.30	1¾	1¾	½	Varies with material, to 1¾	24	610, 910, 1255, 1700	⅓ hp	14x15	0-15°	0-45°	0-45°	5	Full selection	179 (crated)
Four speed, saw and stand, motor and 24-V magnetic control	614.60														
Variable speed, saw only	431.50						807 to 1653								
Variable speed, saw and stand, motor and controls	682.40														
Rockwell/Delta															
Basic saw[3]	378.00	1¾	1¾	½	Varies with material, to 1¾	24	610, 910, 1255, 1700	⅓ hp	14x14	0-15°	0-45°	0-45°	5	Full selection	100
Four speed, motor and stand	520.00														176
Four speed, motor, stand, 24-V pushbutton magnetic control	593.00														
Variable speed, motor, stand	549.00						650 to 1700								170
Variable speed, motor, stand, 24-V pushbutton magnetic control	627.00														176

Accessories available for models noted: [1]Sanding disks, buffing, wire and grinding wheels, wheel guard; flexible shaft, grinding, carving, routing, sanding attachments. [2]Saber blade guide, work lamp. [3]Sanding attachment, set accessory blade guides, carbide files (various shapes), self-centering lower chuck (for fine blades), work lamp, saber-blade guide.

SCROLL-SAW BLADES	Speed	Type of blade	TPI	Blade thickness	Width	PART NUMBER: Rockwell/Delta	Powermatic	Dremel	Sears	Constantine	Note
Rough cutting hard and soft wood to capacity of saw	Fast	Saber	7	0.035	0.250	40-704	—	—	—	—	
	Fast	Saber	7	0.028	0.250	—	6080055	—	—	—	
	Fast	Scroll	7	0.028	0.250	40-194	—	—	—	—	
	Fast	Saber	9	0.025	0.187	40-703	—	—	—	—	
Smooth cutting hard and soft wood to capacity of saw	Fast	Scroll	10	0.028	0.187	40-093	6080054	—	—	—	Best all-around blade for wood
	Fast	Scroll	10	0.020	0.110	40-092	6080070	—	—	—	
	Fast	Saber	10	0.028	0.187	—	6080056	—	—	—	
	Fast	Scroll	15	0.020	0.110	40-191	6080071	—	26874	—	
Smooth cutting hardwood, softwood, plastics and soft metals to capacity of saw	Fast	Saber	15	0.028	0.250	—	—	8032	—	—	Dremel 550 only
	Fast	Saber	19	0.025	0.110	—	—	8031	—	—	Dremel 550 only
	Fast	Scroll	15	0.015	0.187	—	—	8030	26888	—	Dremel 571 only
	Fast	Scroll	25	0.010	0.065	—	—	8029	26887	—	Dremel 571 only
Intricate cutting in veneer, hardwood and softwood to 1/16 inch	Medium	Scroll	20	0.008	0.035	40-184	—	—	—	—	
	Medium	Scroll	25	0.010	0.065	—	—	8029	26887	—	
	Medium	Scroll	30	0.016	0.054	—	6080064	—	—	—	
Intricate cutting of wood, plastics, lead, bone, felt, paper, ivory, copper, gold, silver, aluminum to ½ inch	Slow	Scroll	7	0.020	0.110	40-188	6080062	—	—	—	
	Slow	Scroll	7	0.020	0.070	40-187	6080060	—	—	—	
	Slow	Scroll	12	0.019	0.055	—	6080059	—	—	—	
	Slow	Scroll	15	0.019	0.050	40-185	—	—	—	—	
	Slow	Scroll	18	0.017	0.043	40-196	6080058	—	—	—	
Hacksawing steel, iron, aluminum, brass, copper, pewter, lead; sawing mother-of-pearl, mica, wallboard, hardboard, seashells	Slow	Scroll	15	0.020	0.085	40-161	—	—	—	—	
	Slow	Scroll	15	0.020	0.070	40-160	6080065	—	—	—	
	Slow	Scroll	20	0.028	0.250	40-165	6080069	—	—	—	
	Slow	Scroll	30	0.016	0.054	40-195	—	—	—	—	
Acrylic plastic (Plexiglas) sheets to ¼ inch	Slow	Scroll	32	0.020	0.070	40-058	6080068	—	—	—	1/16 to ⅛ inch
	Slow	Scroll	20	0.020	0.070	40-159	6080067	—	—	—	3/16 to ¼ inch
Very intricate cutting of wood, veneer, metals, bone, mother-of-pearl, etc., up to ⅛ inch	Slow	Jeweler's	32	0.016	0.034	—	—	—	—	6J	
	Slow	Jeweler's	40	0.015	0.032	—	—	—	—	4J	
	Slow	Jeweler's	48	0.014	0.029	—	—	—	—	2J	
	Slow	Jeweler's	56	0.012	0.026	—	—	—	—	1J	
	Slow	Jeweler's	64	0.010	0.021	—	—	—	—	2/0	
	Slow	Jeweler's	70	0.009	0.018	—	—	—	—	4/0	
	Slow	Jeweler's	76	0.008	0.016	—	—	—	—	6/0	

can install a dado blade on a radial-arm saw, or, for that matter, even set the depth of cut.

This wide-ranging capability makes the scroll saw a good first stationary or bench power saw for beginning woodworkers. You can make a lot of furniture with just a scroll saw and a router. And, if you want to start a youngster on power tools, there is no other power saw as safe to operate.

The scroll saw has advantages over a band saw—it can take sharper turns and saw inside holes, something a band saw cannot do at all. However, the band saw does have the edge of higher cutting speed and ability to handle thicker stock (six to 10 in. vs. 1¾ in. for typical home-shop scroll saws).

Outperforms saber, too

Why is the scroll saw able to outperform any saber saw? Unlike the blade of the saber saw that can (and often does) whip about and wander from the straight and vertical, a scroll-saw blade is held true, clamped between chucks at both ends and held under tension while sawing. In addition, most scroll saws also have a notched blade guide that is positioned right at the surface of the work.

Clamping the blade under tension also permits the use of a much finer blade for the same job, producing a narrower kerf and permitting sharper turns. Some scroll-saw blades can actually saw a 180-degree turn in the width of a saber-saw kerf.

But don't think of the scroll saw as only a woodworking tool. It is unexcelled for detailed model building, intricate metalwork, and jewelry making.

With the proper blade—there are about 30 kinds—you can accurately

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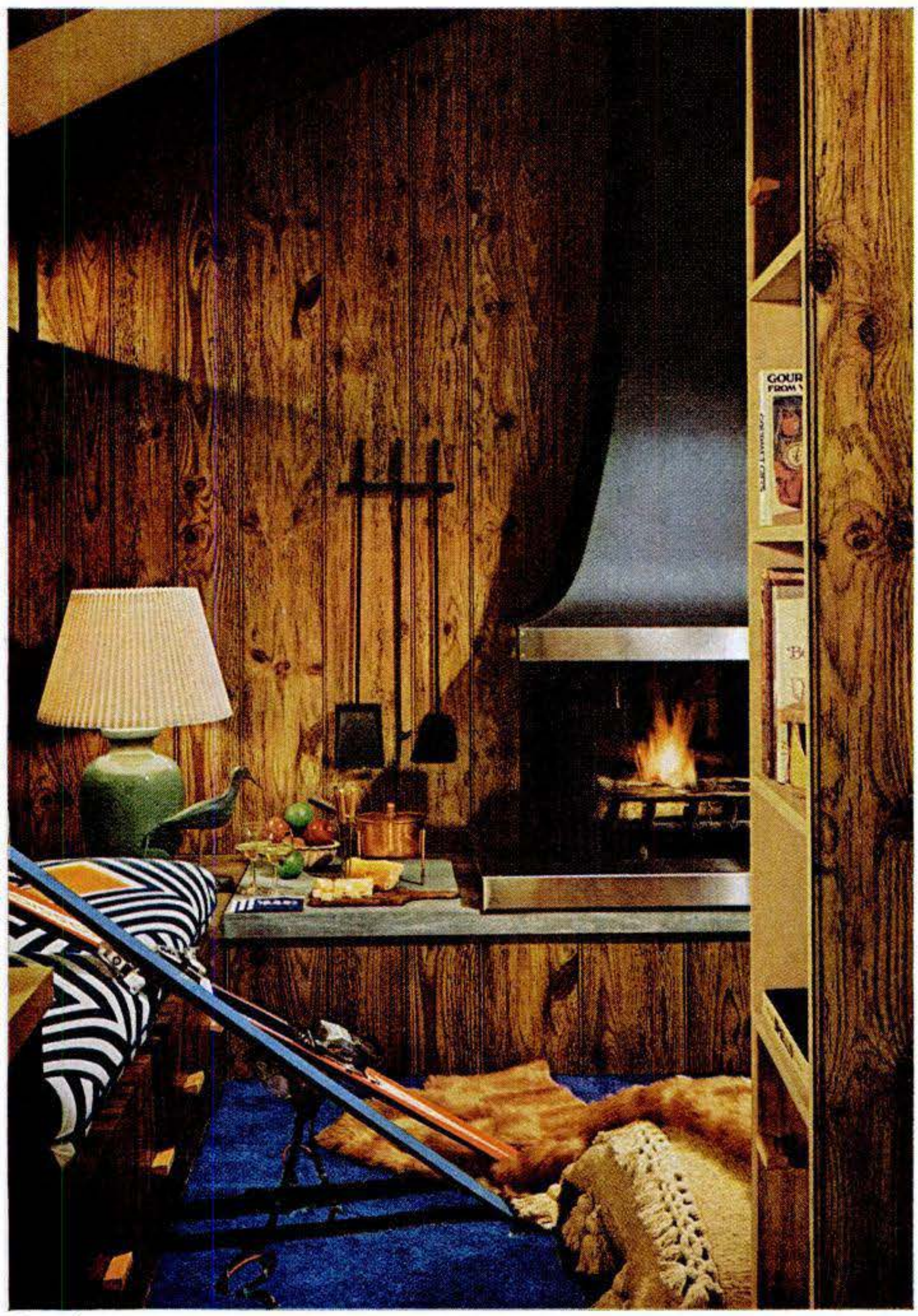

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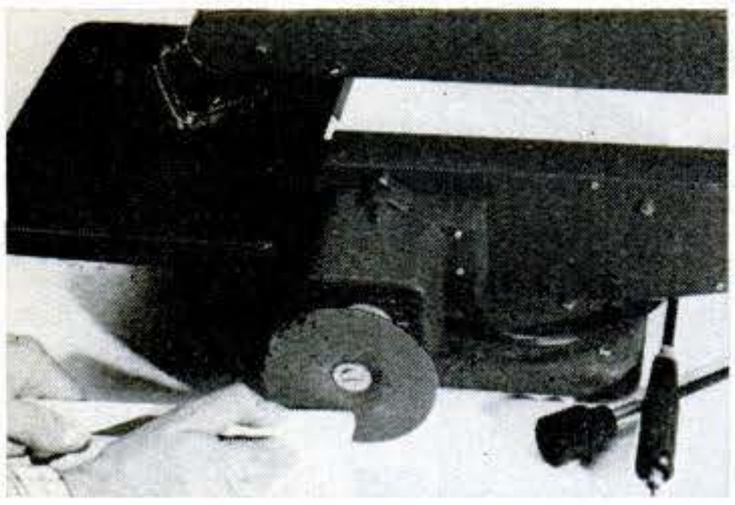
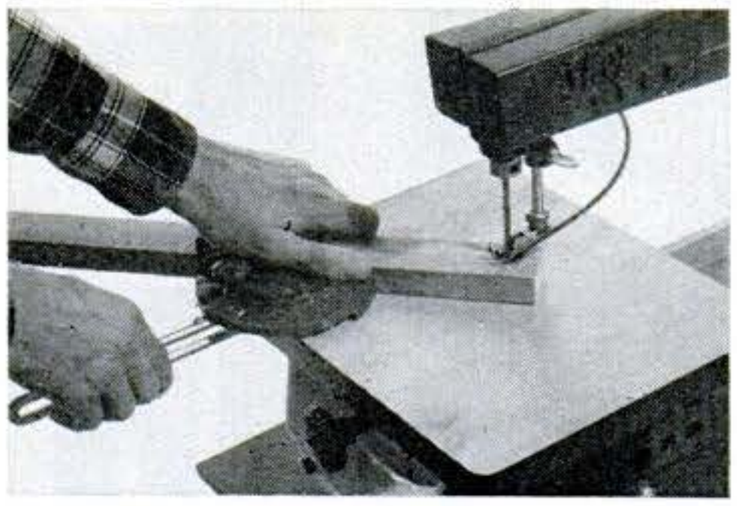


Dremel Model 571 has power-takeoff shaft for sanding, buffing, and grinding wheels, and for flexible shaft that accepts Dremel hand-grinder accessories.



Miter gauge on Shopmaster jigsaws is handy accessory both for crosscutting and ripping. Saws have large, easy-to-read (and set) table tilt control.

cut anything that can be sawn, including such exotic materials as gold, silver, lead, pewter, copper, brass, aluminum, ivory, bone, mother-of-pearl, felt, paper, mica, brake lining, and seashells—to name a few.

Two types of scroll saws are available for the home shop: small tabletop saws, which can be operated on a card table or kitchen table in a small apartment; and larger bench or floor-stand tools. Besides work-handling capacity, there are important performance differences among the various scroll saws.

Let's look first at the smaller tabletop models.

Dremel's Models 550 and 571 are designed for light-duty sawing; nevertheless, they can cut 1½-in.-thick construction lumber. In thick wood, they are far slower than bigger saws, and because of their lighter construction and smaller tables, such cutting requires greater care on the part of the operator in guiding the work into the blade.

In thin wood, both saws cut as fast as the larger ones; speed is limited not by the saw itself, but by your ability to control the workpiece. These saws can also cut plastics and soft metals, but their high blade speed and small number of blades (coarse and fine) limit their use in exotic materials.

The two Dremel saws are quite different in their basic designs. The larger and older of the two, the Model 571 Moto-Shop, is a true scroll saw in that the blade is supported under tension between a lower driving chuck and a spring-loaded upper chuck, and the table tilts for bevel sawing. The 571 also has a power take-off shaft to drive sanding, grinding, and buffing wheels, and a flexible shaft using a full range of Dremel's hand-grinder accessories. The Dremel Moto Shop is an extremely versatile tool, especially for those who are severely cramped for shop space. (The tool is also marketed by Sears Roebuck, under the Craftsman label, and by Montgomery Ward.)

The smaller Dremel Model 550 Moto-Saw is not a true scroll saw: The blade is not supported under tension in a top-end chuck. It can best be regarded as an inverted table-mounted saber saw, but with the added refinement of a blade guide to restrain and control the free end of the blade. It will do a far more accurate sawing job than can be done with a hand-held saber saw; however, the model 550 is not capable of the intricate work typical of other scroll

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saws because of the necessarily wider and thicker saber blades used.

Intermediate woodworking scrolls

The Shopmaster J20 and J2000, and Sprunger J200, scroll saws are in this category. These saws can do all the sawing that the tabletop saws can do—and do it faster and with better workpiece control, particularly in long sweeping curves or straight cuts in thick wood, or in large pieces of plywood. These saws operate at lower blade speeds than tabletop saws, and can chuck a wide variety of standard blades for specialized cutting.

The Shopmaster J20 has an integral 1/15-hp brush-type motor built into its die-cast base. The Shopmaster J2000 is the same saw with a separate, more powerful, ⅓-hp motor. Both saws come equipped with a miter gauge, and stands are available.

The Sprunger Brothers J200 jigsaw is a basic, no-frills woodworking scroll saw built like a battleship. The drive pulley is located in the bottom of the cast-iron housing and is driven by a motor located below the bench top. While this is a good idea for safety—getting the belt below the bench—it makes setting up any adjustable-speed drive more involved.

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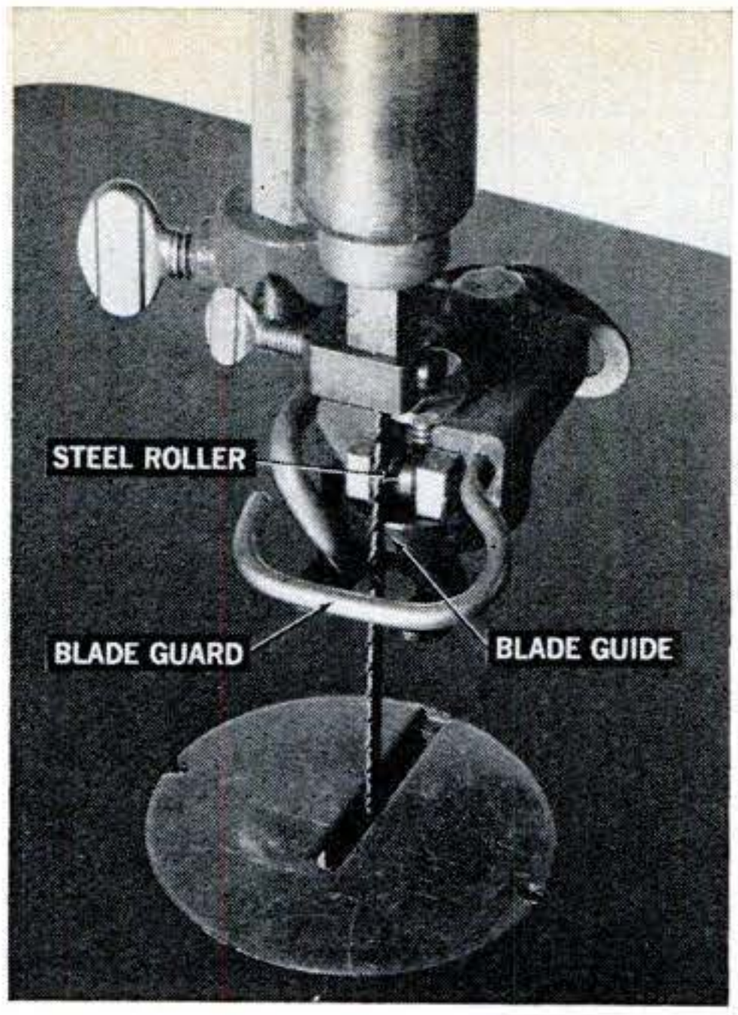

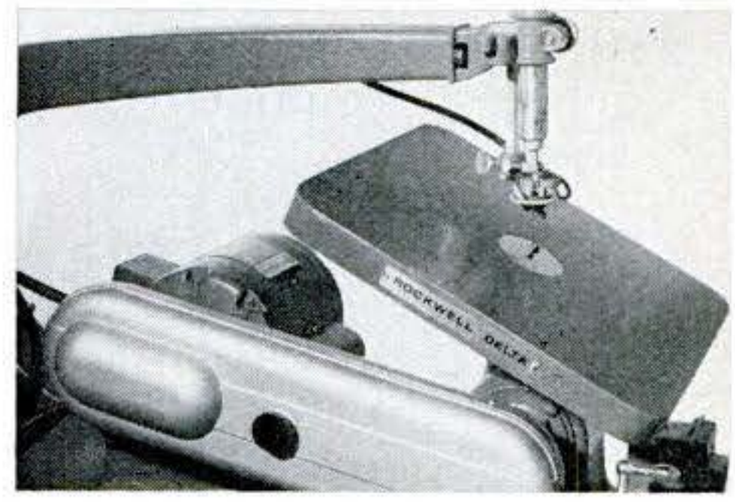

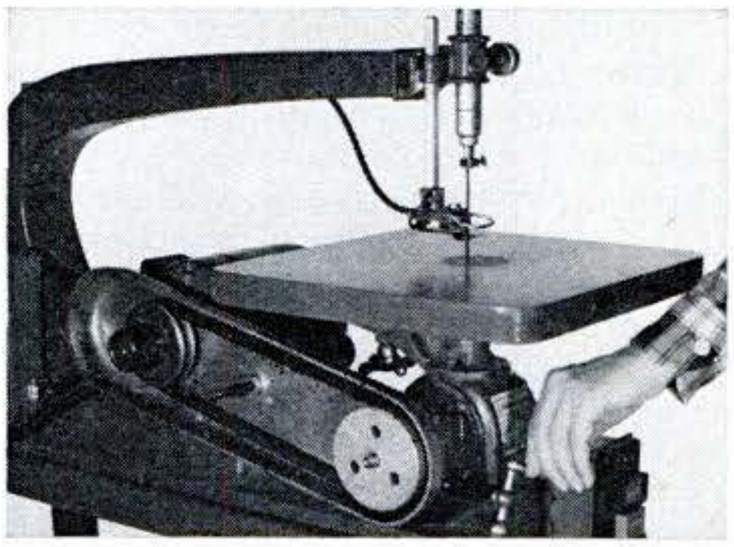

Rockwell/Delta features: Heat-treated steel roller (left) prevents wear on blade guide; blade guard keeps fingers clear of work. Variable-speed drive (below, left) provides any speed from 650 to 1700 cutting strokes per minute. Table (below) rotates when blade is ripping. Filing, cutting, and sanding accessories (bottom, left to right): round, half-round, square, and triangular carbide files; 40-704 and 40-703 saber blades; sanding sleeve and sanding attachment with ¼" shank.

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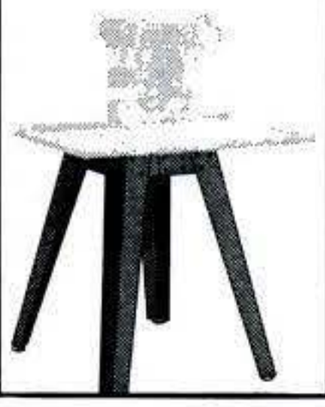
• 15-piece molding head set • Molding head guard • 16-tooth carbide-tipped dado • 10-inch plywood crosscut blade • 10-inch hollow ground planer blade • Goggles			

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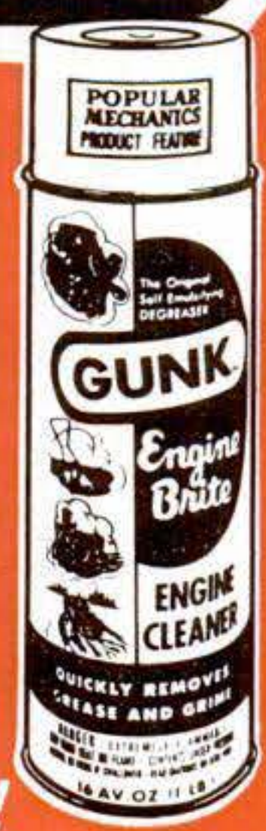

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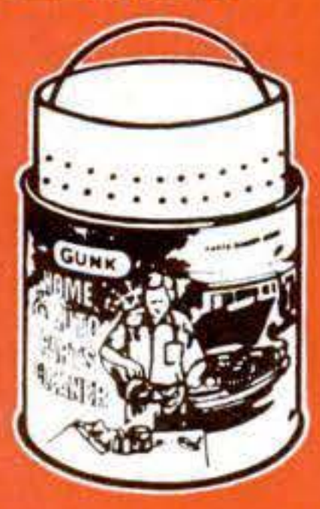

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Scroll saws

[*Continued*]

My recommendation with either the Shopmaster J2000 or the Sprunger saw: Modify the belt drive for adjustable speed, so that the saws can be operated at lower speeds for metal cutting and intricate, exotic-material work. In the Shopmaster J2000 this would involve installing step pulleys in place of the one-diameter type supplied. Because of the small size of the Sprunger's drive pulley, you'd need to provide an intermediate shaft and pulleys for variable-speed drive on this scroll saw.

Large scroll saws

The Powermatic and Rockwell/Delta 24-inch scroll saws are roughly equal. Both can be obtained with either four-speed or continuously variable-speed drives. Both saws can perform several operations that the preceding saws cannot. Their tables can be rotated when the blades are turned for bevel ripping; and for saber sawing, the entire overarm assemblies can be removed, letting the saws handle work of any size (limited only by the size of your shop and what you can manhandle).

Besides the usual flat jaws, the lower chuck of the Rockwell/Delta saw also has V jaws for a better grip on saber blades and to accommodate round-shanked sanding and filing accessories, giving it the edge in versatility.

If you've ever tried to sand an edge by hand you know how difficult it is to avoid rounding it over. With the sanding and filing attachments clamped in the V jaws of the lower chuck, the Rockwell/Delta scroll saw will work pretty much like a spindle sander, enabling you to sand irregular edges quickly.

Choosing blades

Except for the two Dremel tools, which use three-inch blades, all of the scroll saws use standard interchangeable five-inch-long plain-end blades, called scroll-saw, jigsaw, or fret-saw blades.

Quickly compared, many of the blades look alike, but there are differences in the number of teeth per inch (TPI), the set or lack of set in the teeth, gaps between teeth, blade thickness and width, and temper. All of these variations determine what the blades will cut efficiently (see blade chart with this article).

Jeweler's blades can also be used. These are much thinner than the finest scroll-saw blades and run all the way to 76 TPI. Needless to say, they must be used carefully. You can use them to do extremely intricate work in miniature modelmaking and jewelry crafts. (When doing this kind of work, make an auxiliary table by sawing to the center of a piece of hardboard to support the work right to the edge of the blade.)

With the exception of the Dremel 571, all of the scroll saws can also be operated with saber blades. You should use a saber blade when you have many inside holes to cut out, because you can avoid chucking and unchucking the blade each time you change holes.

Scroll-sawing tips

When cutting thin material, the teeth must be closely spaced, with at least three teeth bearing against the cut at all times so a tooth cannot snag on the top edge of the work and break the blade. With practice and a steady hand, you can sometimes cheat on this requirement by feeding the work into the blade very slowly and evenly. An alternative to using a delicate fine-toothed blade for material less than 1/16-inch thick is to tape the work to scrap hardboard with double-faced tape, and saw both together. This way you can saw brass shim stock. The metal and backing can be separated without bending by dunking it in either lacquer thinner or acetone.

Some brittle materials tend to chip on the upstroke; this can be reduced by sandwiching the material between pieces of hardboard or other scrap material for sawing.

Sawing plastics

Sawing plastics is an art in itself. On cold days phenolics should be warmed to about 80° F to reduce brittleness and chipping. Acrylics such as Plexiglas should always be sawn with the protective paper left on. The paper breaks up the chips and prevents them from being dragged into the kerf behind the blade while still hot, where they fuse with the sides of the cut. All plastics should be cut at a slow blade speed.

When sawing aluminum, lubricate the blade by rubbing it with beeswax. Ferrous metals require lubrication with cutting oil. Brass and copper should be cut dry.

You should always use the widest blade that will negotiate the curves in your work. Narrow blades are inherently hard to steer. A coarse-toothed blade saws faster in thick material than a fine-toothed one, but it also leaves a rougher kerf. If the edge is going to be visible in the finished work, particularly if it must be sanded by hand, you're well advised to use a fine blade to begin with and possibly avoid the need for sanding.

Don't crowd the blade. Feed the work slowly. Forcing a blade into the work makes the blade twist and go off the line.

Besides being slow, a dull blade is uncontrollable, overheats, and is prone to breaking. Put in a fresh blade whenever you begin to wonder what happened to your skill. PS

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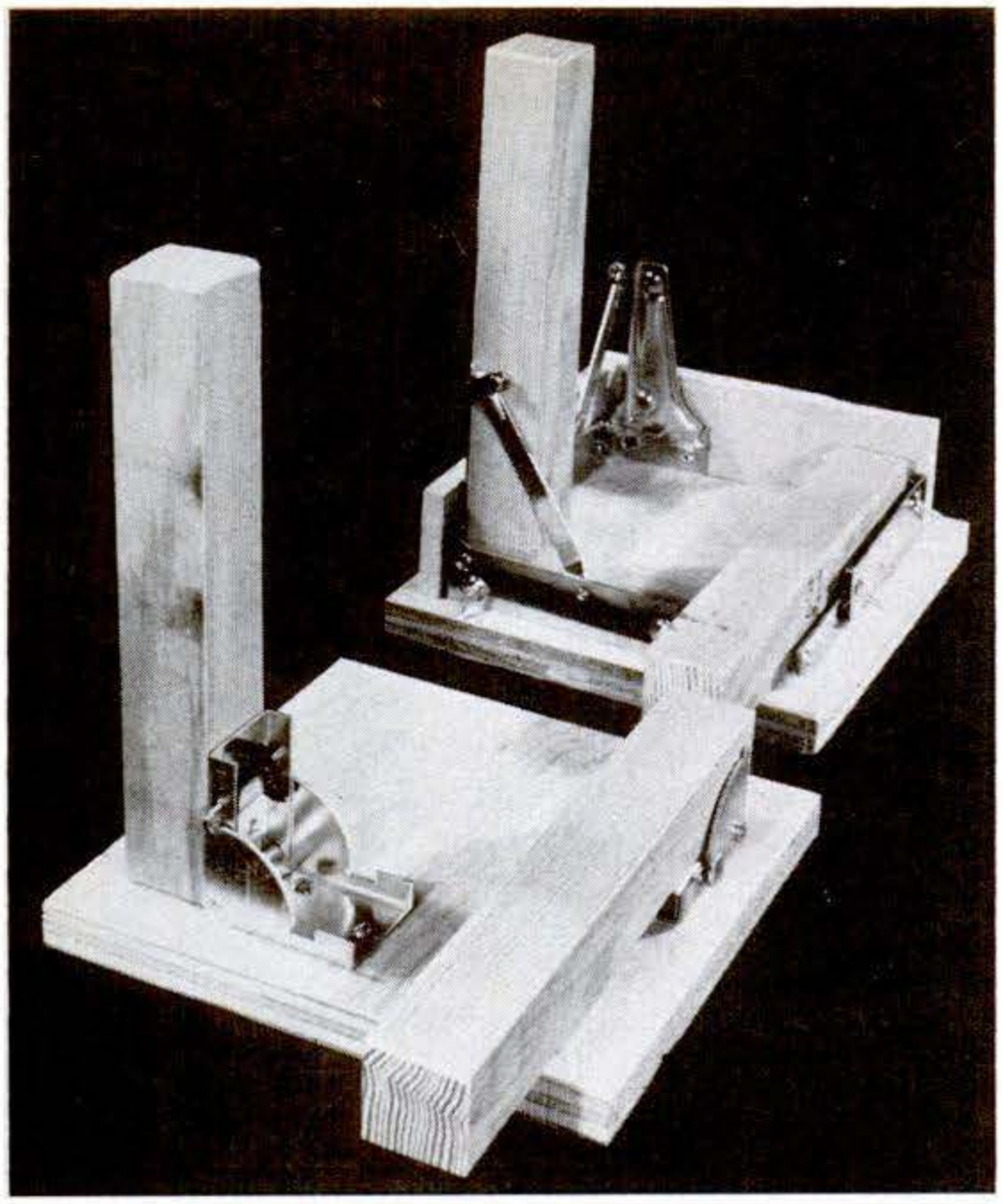
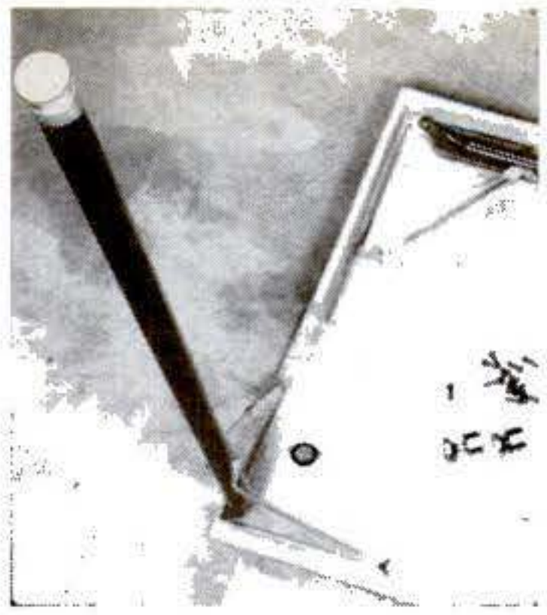
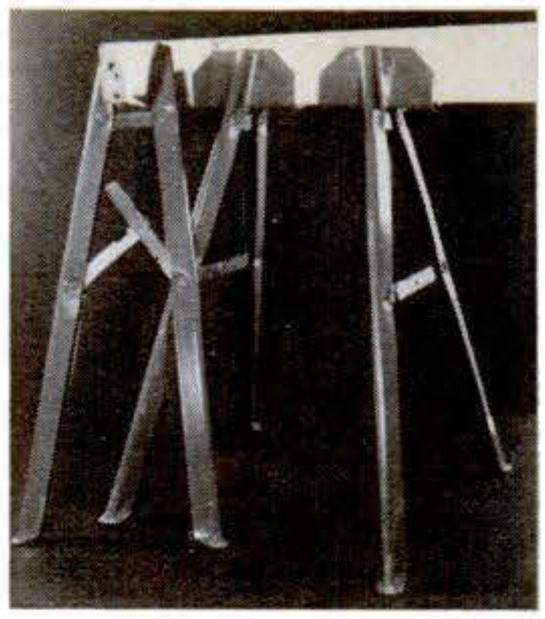
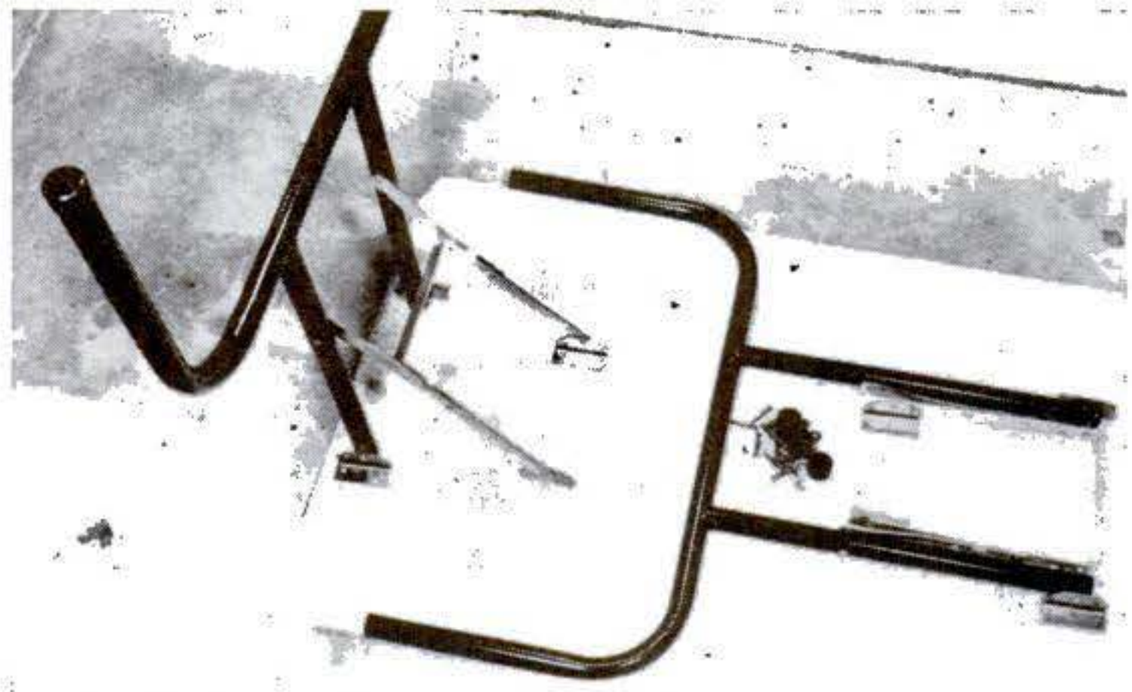


Use hinged brackets to make folding tables, benches, or platforms. Cut a top from plywood, and attach legs with E-Z type brackets (foreground above). To fold down between bracket sides, legs must be no wider than 1½". A set of four brackets is $6. Stanley #448 card-table leg braces (background) fasten to an apron, rather than to a table top. Legs must have one flat side. A set of four: about $10.







Folding-leg sets let you fashion tables for any purpose. Game-table legs (top left), fastened within the recess of a tabletop frame, make a very steady table. A set of four legs is $11-$16. Folding steel sawhorses (top right) bite a 2x4 firmly when center brace is extended, to make instant supports for temporary table. Price: $6-$12 a pair. Banquet legs (above) are best for long tables. Price: $17-$24 a set.

Fall Home Value Ideas

Create your own space-saving tables with folding-leg hardware

Starting a new hobby . . . throwing a huge party . . . getting into outdoor cooking . . . these and hundreds of other leisure activities practically demand special tables and work areas. But what do you do with this extra furniture when you're not using it? Fix it so you can fold it flat.

Of course, you can buy folding tables and benches—but you can also make them yourself, using the clever, well-made hardware shown on these pages. You'll not only save money this way, you'll also be able to make the exact size and style of folding furniture you need.

The photos above show you mock-ups of several kinds of folding hardware. Here's the rundown on what you can do with different types:

- Hinged leg brackets let you use your own wood for folding legs. The E-Z type screws to the legs and bottom face of a tabletop. A spring-loaded latch button locks the bracket in either the upright or folded position. Lacking braces, these brackets can be a bit wobbly, but you can stiffen them with folding leg braces. Unbraced, they're fine for light, relatively short-legged tables. Another application: Use them for short legs on a folding platform, such as a carpet-covered, plywood deck for the back of a station wagon.

For a very rigid table, use the Stanley braced brackets. Remember, though, that the tabletop must be slightly larger than the length of the legs, since each folded leg must clear the bracket on the next corner.

- Game-table hinged legs come in both the tubular style shown and in wrought iron. One useful feature of the legs shown: You can cut them down from their 29-inch length to make a custom table. It's easy to reinsert the swiveling base levelers into the shortened ends.
- Hinged sawhorse legs are good for many uses besides making sawhorses. Use these two-foot-high, scissors-like legs to support work benches, outboard-motor stands, and even picnic tables. Whenever the horses hold up a table top, be sure to temporarily clamp the top to the 2x4's it rests on.
- Banquet folding legs have uses outside the catering hall. Use them at home whenever you need a really large, sturdy table—for buffets or outdoor parties, for broad work space in your shop or as a pasting table for wallpapering. These U-shaped legs come in either black or chrome. The set shown is 29 inches high, and 24 inches across the "U," giving ample leg room. To fold flat, the table must be at least 60 inches long.
- Folding picnic-table legs (not shown) are an ingenious space saver. Attached to your own wood, the formed, galvanized steel tubing creates a one-piece table/bench unit. One end of each leg braces the table; the other curves out and up on each side to grip the benches. Release a locking nut under the top and the whole unit collapses sideways.—*Mack Philips*

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MAIL-ORDER SOURCES:

Craftsman Wood Service Co., 2727 S. Mary St., Chicago IL 60608 (for #448 Stanley braces and banquet legs); **Constantine's,** 2050 Eastchester Rd., Bronx NY 10461 (for E-Z brackets and #448 Stanley braces); **Minnesota Woodworkers Supply Co.,** Ind. Blvd., Rogers MN 55374 (for E-Z brackets, banquet legs, picnic- and game-table legs); **Sears** for picnic-table legs and sawhorse legs.

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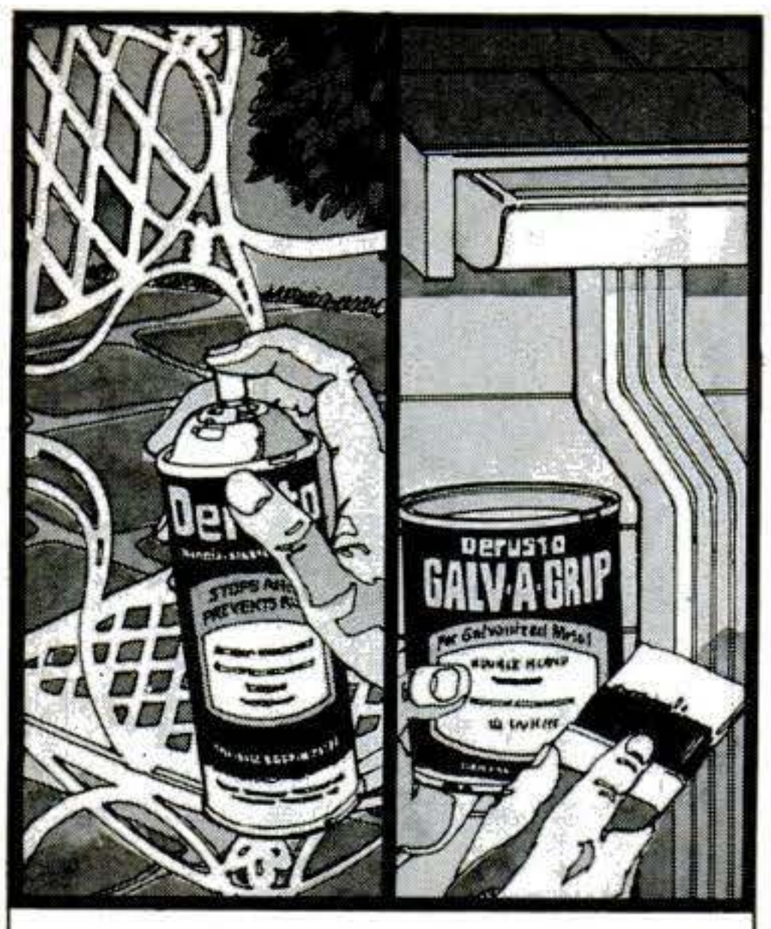

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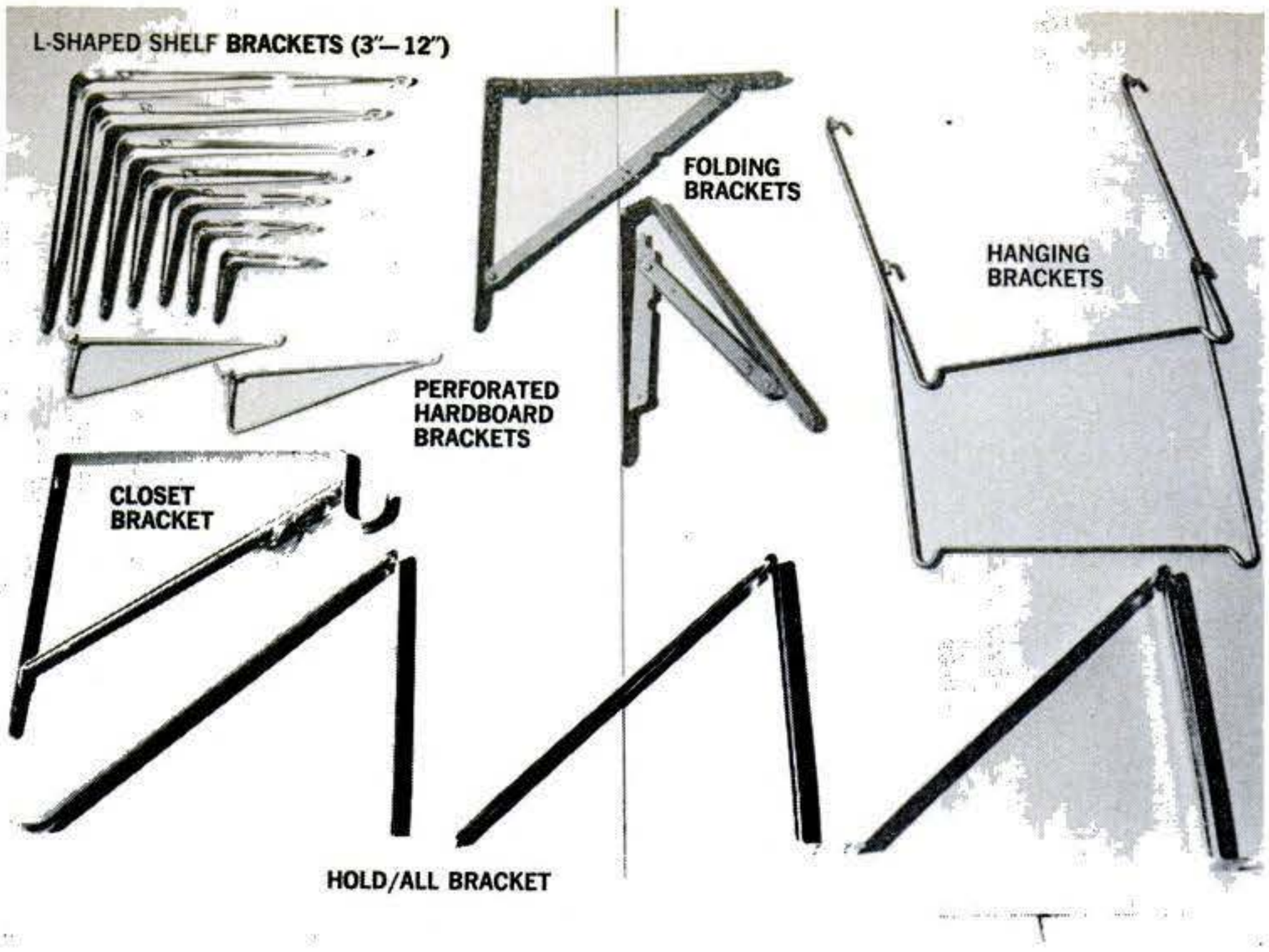


Fall Home Value Ideas

Clever, versatile utility-shelf hardware

Whatever attention is given to shelf hardware seems to go to the fancy stuff. Slick designs for the living room get the attractive displays at home centers and the four-color ads in the magazines. But also available—if less promoted—are utility-shelf hardware items that can give you almost instant storage capability—something that none of us ever seems to have enough of.

Besides the old standby L-shaped shelf brackets, which come painted or bright-plated in seven sizes from 3″ to 12″, there are clever designs—some new—that you may not know about.

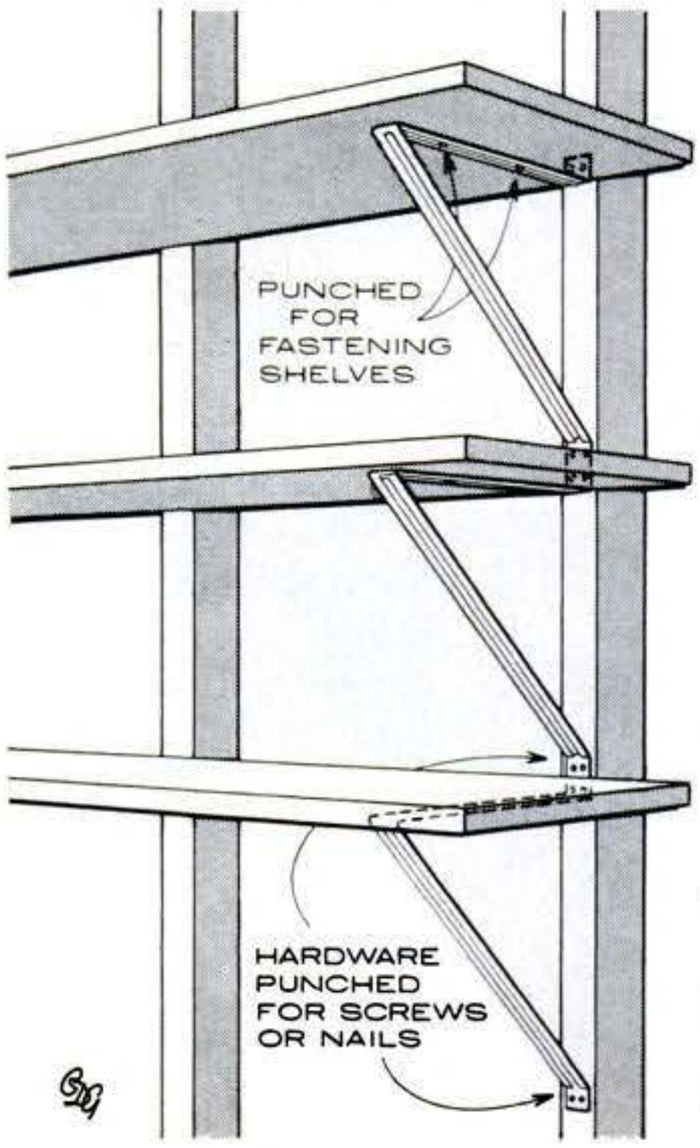
Stanley has a neat folding bracket (top row, center in photo above). These are great for use where part-time storage is needed, but you want the entire space free of obstacles the remainder of the time. Folding hardware is also an excellent way to make a small fold-down bench, perhaps for working on your car or for potting plants.

While we normally think of mounting storage units on walls, you don't need a wall for a clever new set of hanging hardware available from Sears and Gerber. This system is designed to hang from the studs or ceiling of a garage, basement, or storeroom. After it's hung, you just slide 12″ shelf boards into the spaces provided in the hangers (see drawing).

For a quickly installed multishelf storage unit, the new Hold/All (LBH) shelf brackets are hard to beat. Each set will hold three shelves, and you can string them together all the way up the wall (in multiples of three, of course). One Hold/All set zigzags along the bottom of the photo above, and the system is diagrammed below.

Light-duty shelves are a snap if you have perforated-hardboard storage walls in your shop or garage. Simply install perf-board shelf brackets (Masonite and Leigh), and lay a board on top.

You might not think that closet-pole shelf hardware could be used for utility shelving, but it can. A pair of brackets provides a place for a shelf, and the pole saddles can be used as hooks for hanging wire, rope, hose, or



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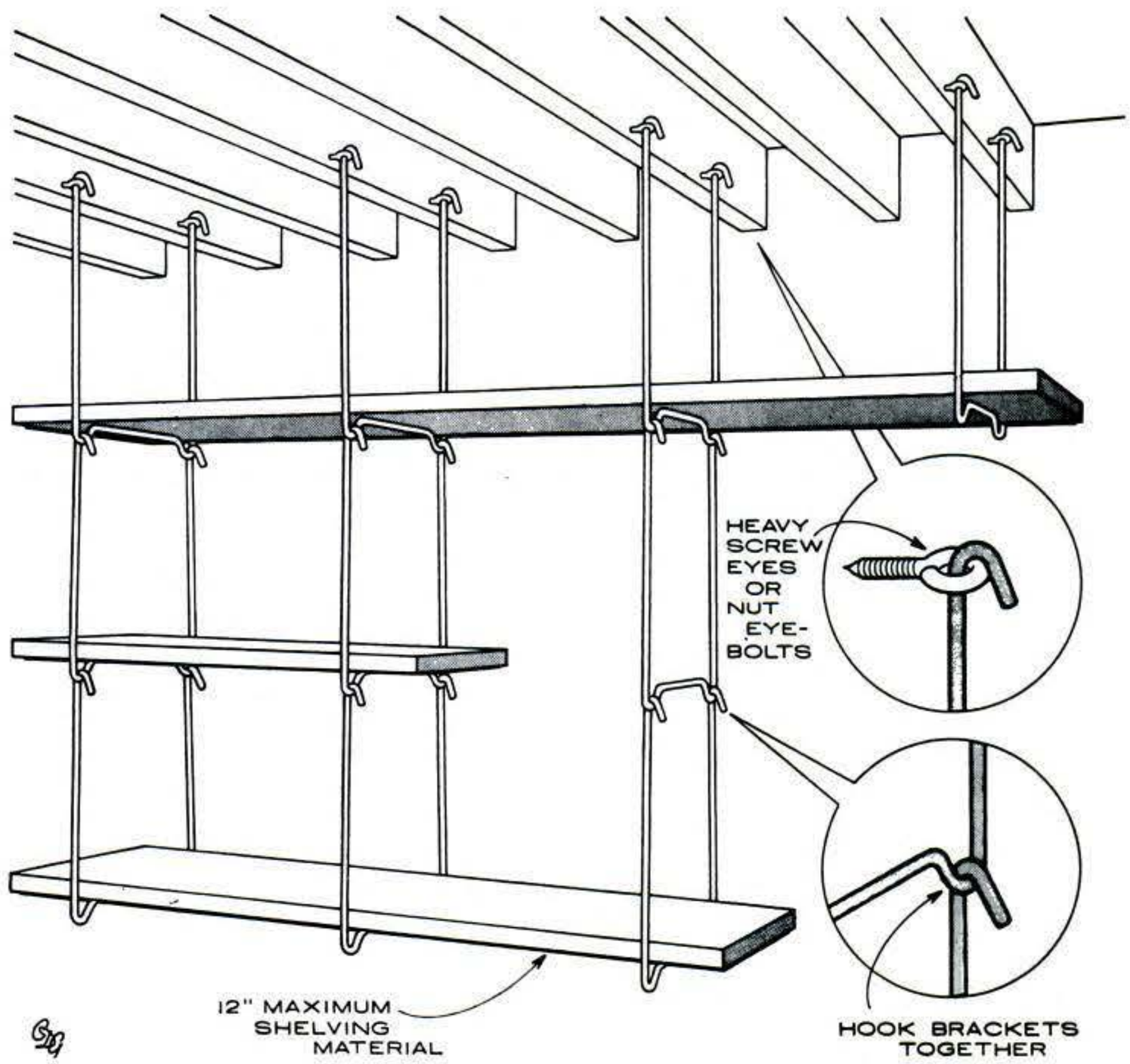
whatever. Put a pole across the saddles and you have storage for out-of-season clothing, tents, and tarps.

Be sure you use enough brackets or hardware to support the intended load and to keep the shelf from sagging. If you're fastening the hardware to studs, use all the holes provided. If nails are used, use good-sized ring-shanked or cement-coated nails for better holding power. Good-sized screws or lag bolts will do the best job, of course. Use hefty concrete anchors on concrete walls. If you're fastening to plaster, paneling, or sheetrock walls, use the biggest possible blind anchors (toggle or Molly bolts) and keep loads reasonable.

Three-quarter-inch (utility-grade) lumber used to be the standard for shelving, but nowadays you might get by better and more cheaply by using ripped strips of particleboard or sheathing-grade plywood. Some lumber dealers have ready-cut particleboard shelving for sale.—*Mack Philips*



MAKERS AND SUPPLIERS

Gerber Industries, Inc., 1570 Fairview Ave., St. Louis, MO 63132; **LBH Inc.,** 16611 S. Broadway, Gardena, CA; **Leigh Products Co.,** 1870 Lee, Coopersville, MO 49404; **Masonite Corp.,** 29 N. Wacker Dr., Chicago, IL 60606; **National Mfg. Co.,** Sterling, IL 61081 (makes conventional L-shaped shelf brackets); **Sears,** retail stores and catalog; **Stanley Hardware Div.,** 195 Lake, New Britain, CT 06050.

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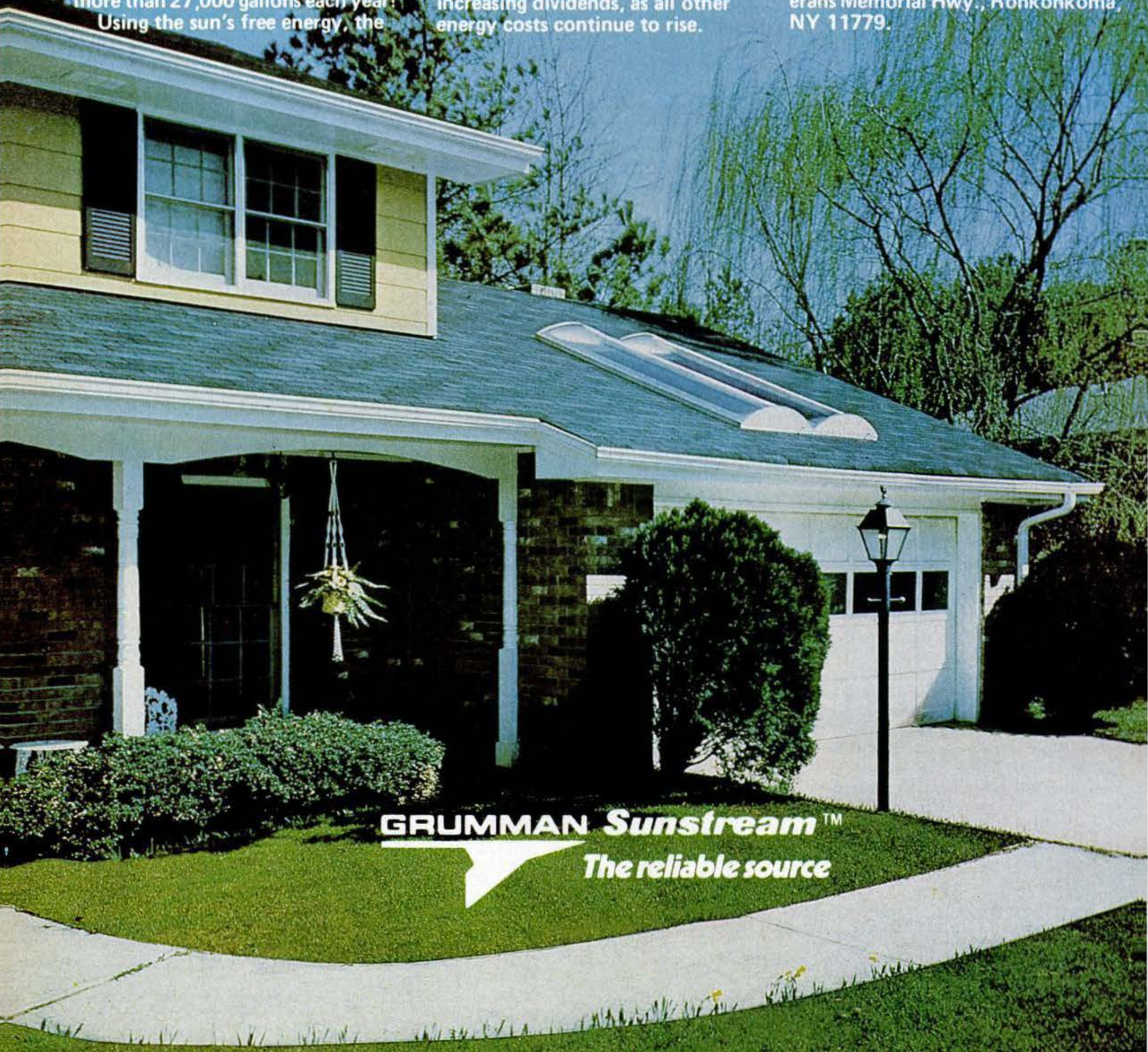

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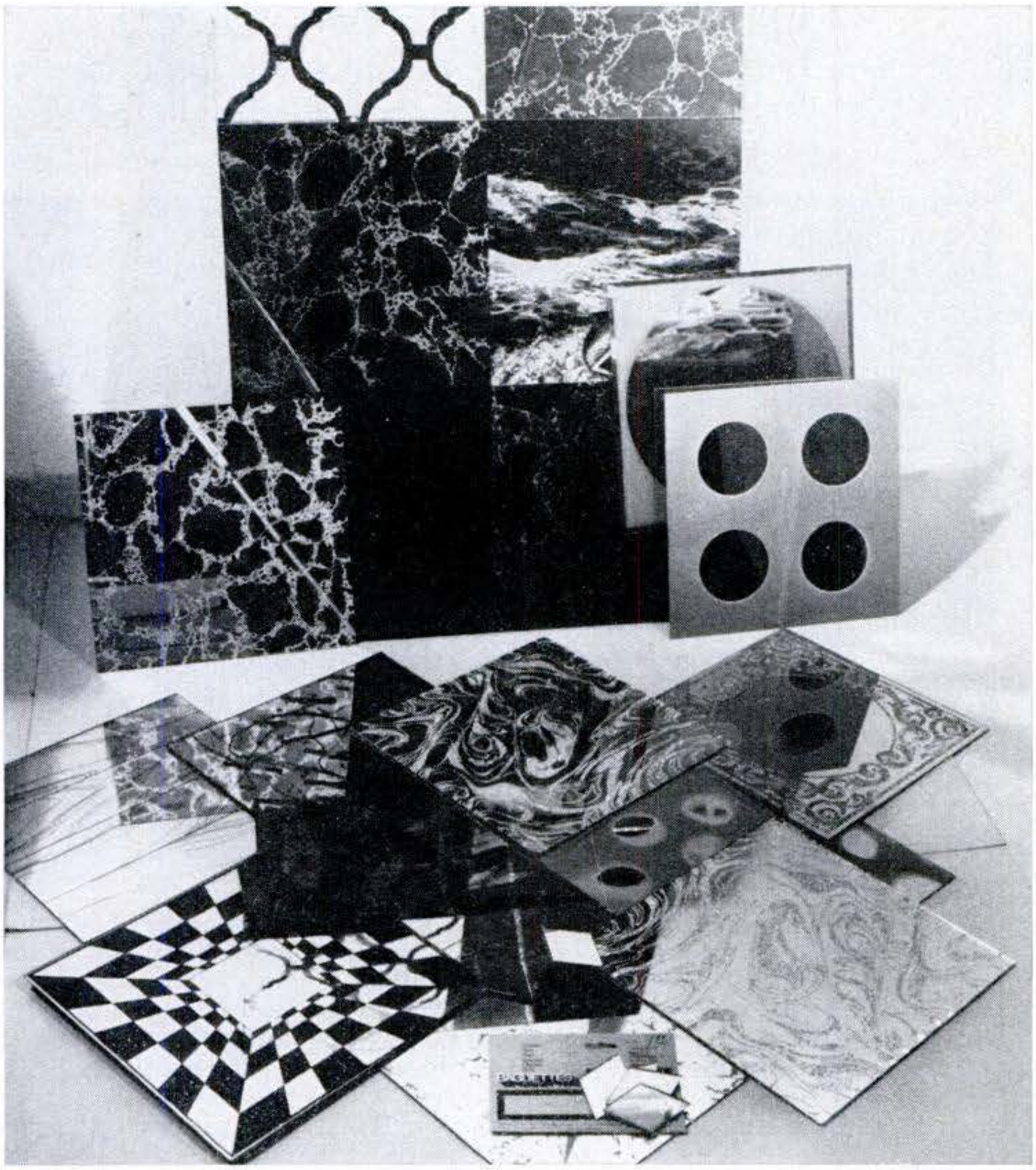
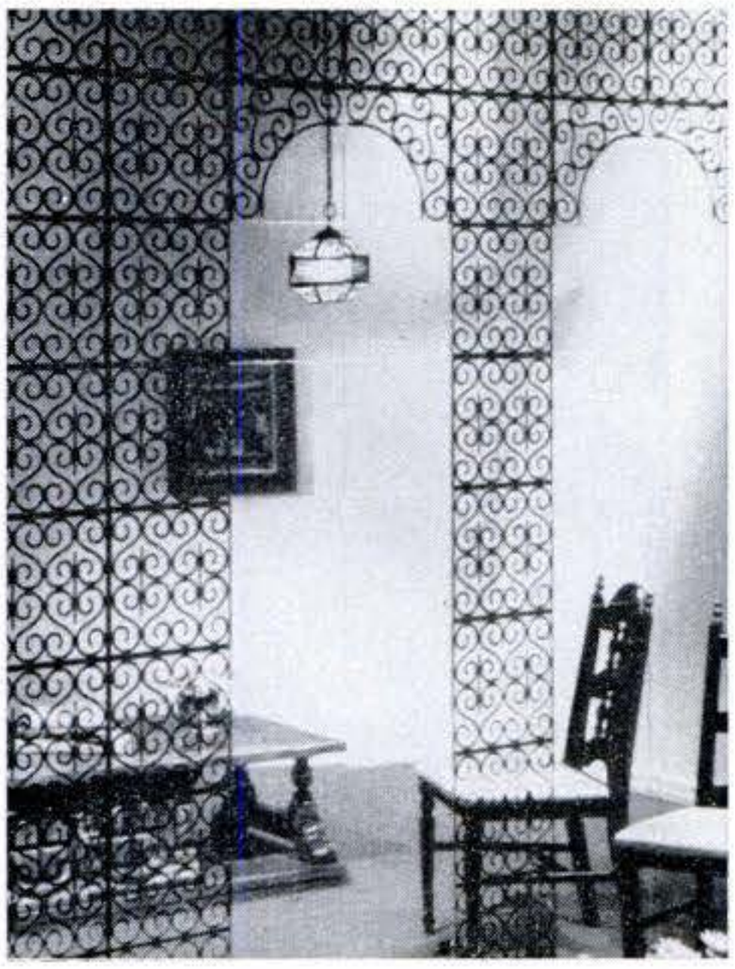
Fall Home Value Ideas

Mirror tiles— a quick face-lift for drab walls



From abstract swirls to op art, this collection of mirror tiles reflects the variety of options available. The designs come in many hues; backgrounds can be clear or smoke-tinted.



This room-expanding wall simulates wrought-iron grillwork. J.C. Penney achieves the effect with a carefully planned mix of plain, patterned, and bordered mirror tiles.

A single, plain mirror tile placed above a simple shelf turns a closet door into a "dressing vanity." For last-minute checkups, adapt the idea to an entrance-hall closet.

Foot-square mirror tiles were once innocuous pieces of mirror glass that you installed with sticky black mastic. But their bland image has been shattered. Today's mirror tiles come in an array of slick designs, ranging from ultra-modern to classic. Choice of sizes has expanded, too. In addition to the 12-by-12-inch tile, you can now get six-by-12-inch and two-by-six-inch tiles for borders and special effects. You can even get a set of six mirror tiles that combine to create a scenic picture. And at least one maker offers baguettes—small, diamond-shaped tiles to stick over corners to give a custom-finished look.

The new mirror tiles are also easier to install. Instead of messy mastic, most come with double-faced pressure-sensitive tape. You just stick a piece on each corner of a tile's back, then press the tile into place.

Easier installation means you can change the character of a room almost instantly by paneling a wall with patterned mirrors. But don't overlook plain mirror tiles for special uses. A dozen plain tiles stuck on a door make an inexpensive, full-length mirror. For a fancier door mirror, one manufacturer offers a set of plain 16-by-14-inch tiles with a border detail.

Single tiles are useful, too. Put one on a closet door (shown) or on a bathroom wall for a small child who can't reach the regular mirror.

To install mirror tiles, you need a reasonably smooth, clean wall. Instructions for wall preparation vary with different brands. One maker suggests that any uneven wall be covered with hardboard before putting up tiles. Most manufacturers also list types of wall surfaces, such as flocked wall paper, that the tape won't stick to. They also recommend laying out a level line to start, and trimming to fit a crooked ceiling or floor juncture. To trim, you use a glass cutter—all brands we checked have cutting instructions.

Wear gloves when handling mirror tile. And, when the tile is exposed on the edges, it's a good idea to rub the sharp surfaces with silicon-carbide abrasive paper before installation.

Of course, you can't stick mirror tiles everywhere. Some manufacturers warn that the tile should not be installed on steamy bathroom walls, ceilings, floors, certain doors—or in any spot where breakage would be hazardous.

What happens if a tile does crack—or if you want to change the decor? The tape makes removal fairly easy. Just slip a putty knife under the tile's edge, and carefully pry the tape bond loose.—*Mack Philips*

MAKERS AND SUPPLIERS OF MIRROR TILE

Color Tile Supermarts, P.O. Box 2475, Ft. Worth, TX 76115; **Decocraft, Inc.,** 20 Kansas, Hackensack, NJ 07601; **Hamilton of Indiana,** 2000 Chestnut St., Vincennes, IN 47591; **Hoyne Industries,** 1058 E. 230th St., Carson, CA 90745; **Jes Enterprises, Inc.,** 4504 Church Ave., Brooklyn, NY 11203; **Mechanical Mirror Works,** 230 Fifth Ave., New York, NY 10001; **New Age Mirror and Tile Industries, Inc.,** 65 Empire St., Newark, NJ 07114; **Unitron Co.,** 12824 S. Cerise Ave., Hawthorne, CA 90250; **Sears, Wards, Penneys** and other retail stores.

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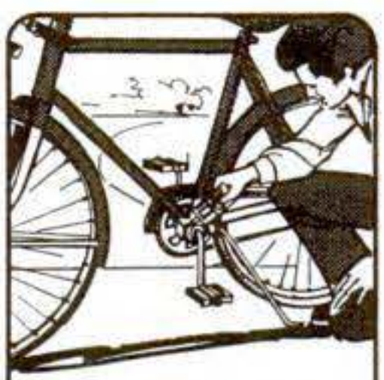

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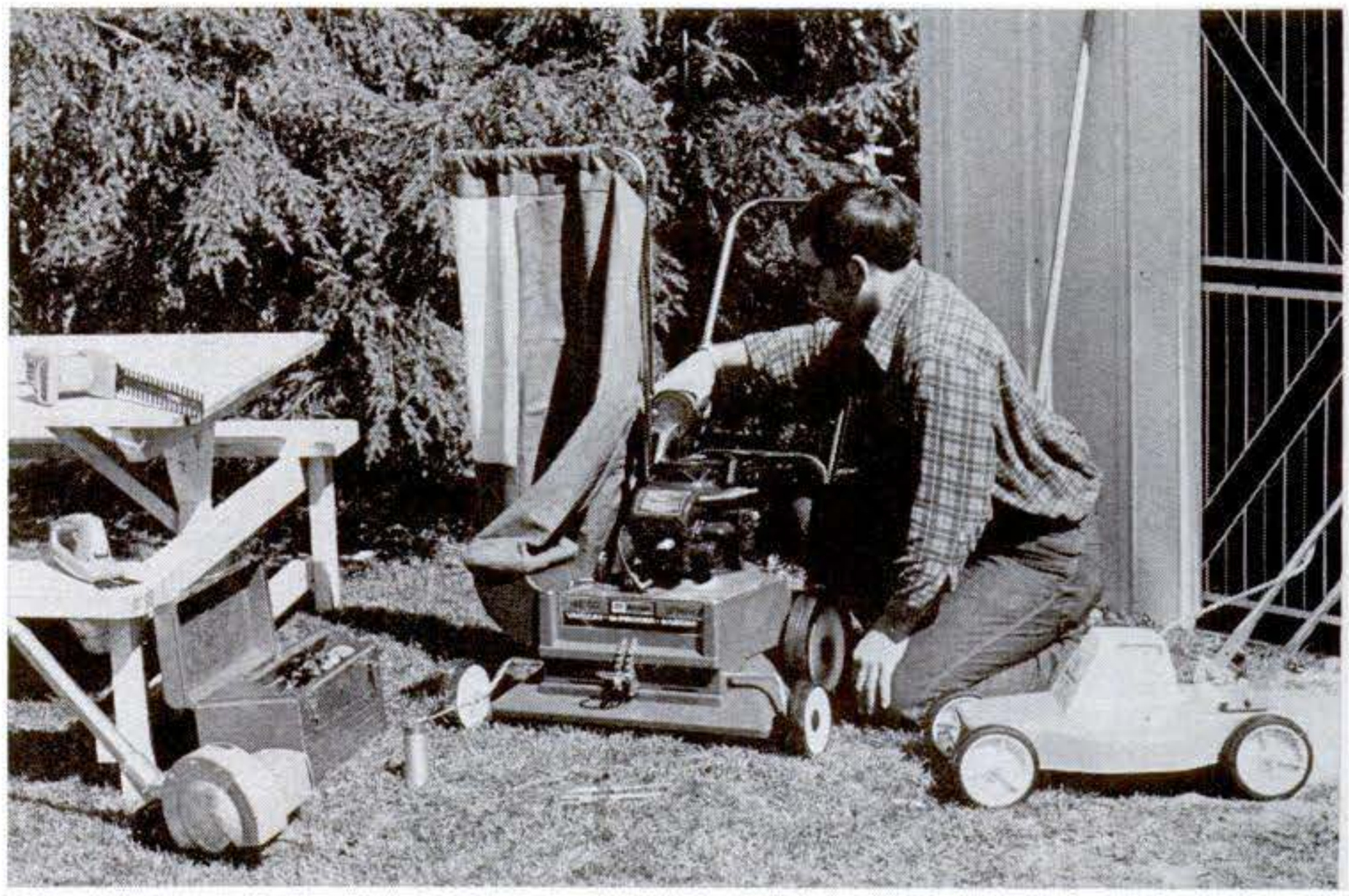
Fall Home Value Ideas

Yard-equipment storage—a little care now saves a lot of care next spring



With summer past and winter fast approaching, your lawn and garden equipment is about to get shoved to the back of the shed, perhaps still caked with dirt and grass clippings. Without adequate preventive maintenance now, you may need a mechanic to get your machines operating next spring. But if you follow the procedures outlined below, and illustrated in our photos, you'll almost guarantee easy starting and reliable service when the leaves and grass—and weeds—pop out again a few months hence.

Before we discuss just what you should do, here are a few words of caution:

- When cleaning gasoline-engine-powered equipment, remove the high-tension lead to the spark plug to prevent accidental starting (photo below).
- When cleaning an electric-motor-powered tool, disconnect the power cord; also disconnect the lead to the battery and/or place the safety-lock switch in the lock position.
- Be sure any engine or motor is

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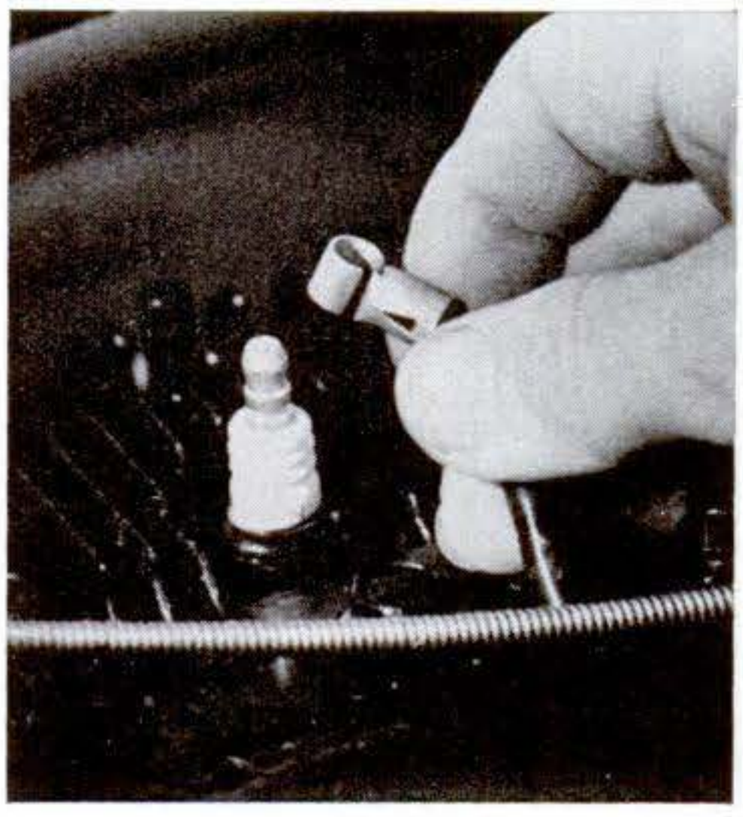

First rule of safety when working on engine-powered machines: Disconnect spark-plug wire even if you've drained gas. Fumes can cause engine to pop over. Make sure wire can't flop back into contact.

Scrape, scrub, brush, wash all tools to get rid of cuttings and dirt. If you do nothing else, do this—and use wooden stick or dowel, never a sharp metal tool. Oil or paint bare spots.

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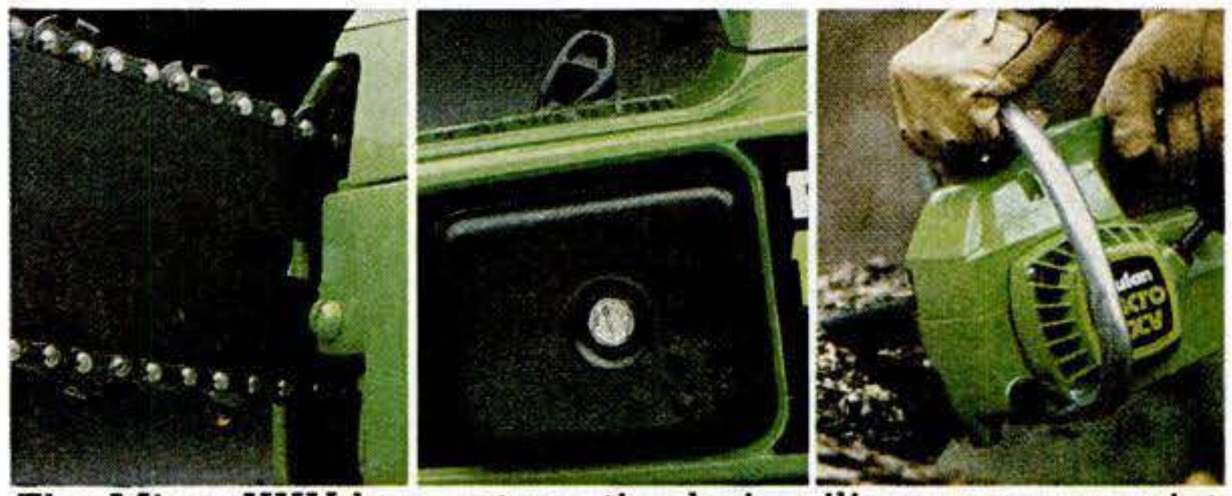

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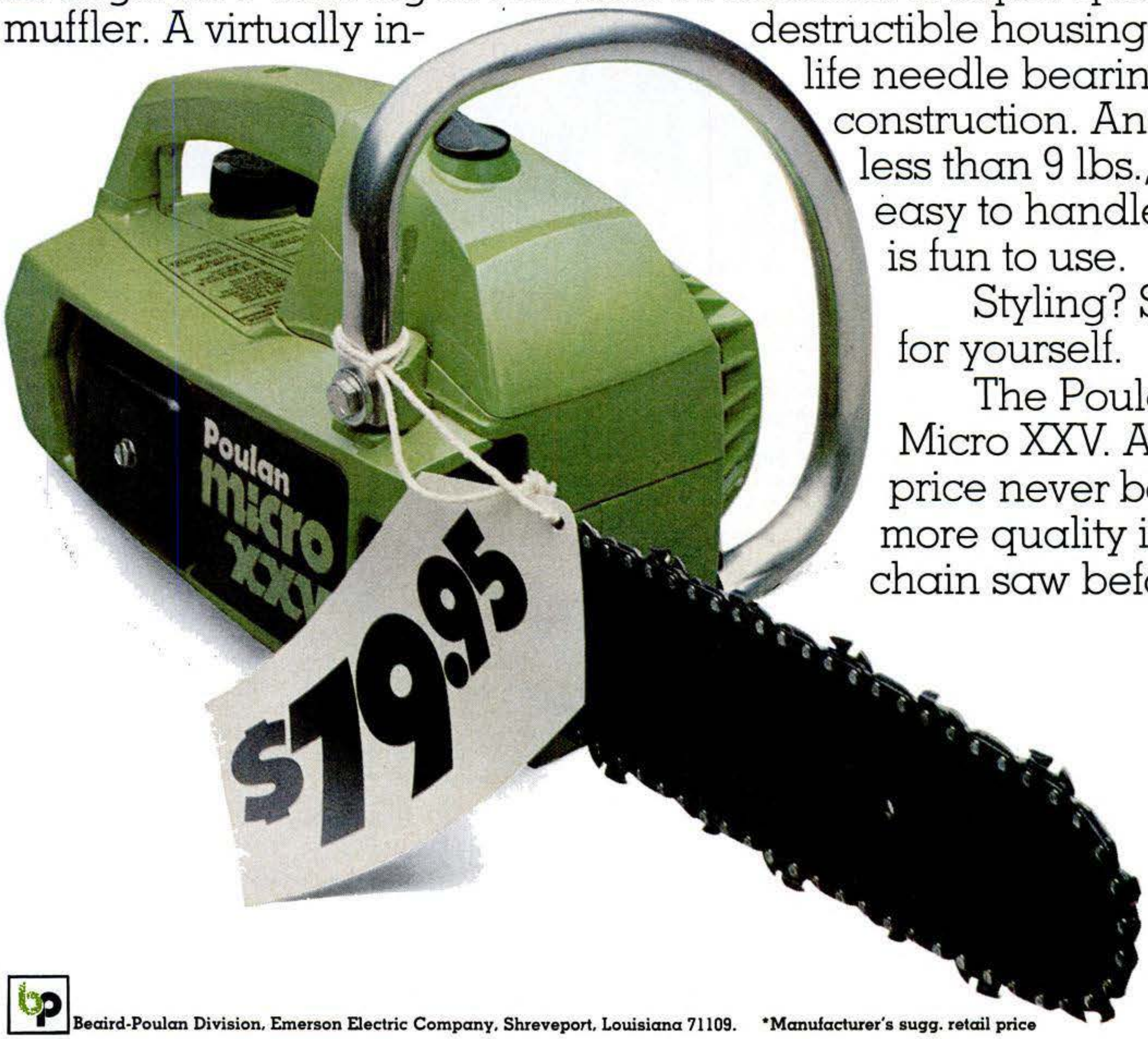

Beaird-Poulan Division, Emerson Electric Company, Shreveport, Louisiana 71109. *Manufacturer's sugg. retail price

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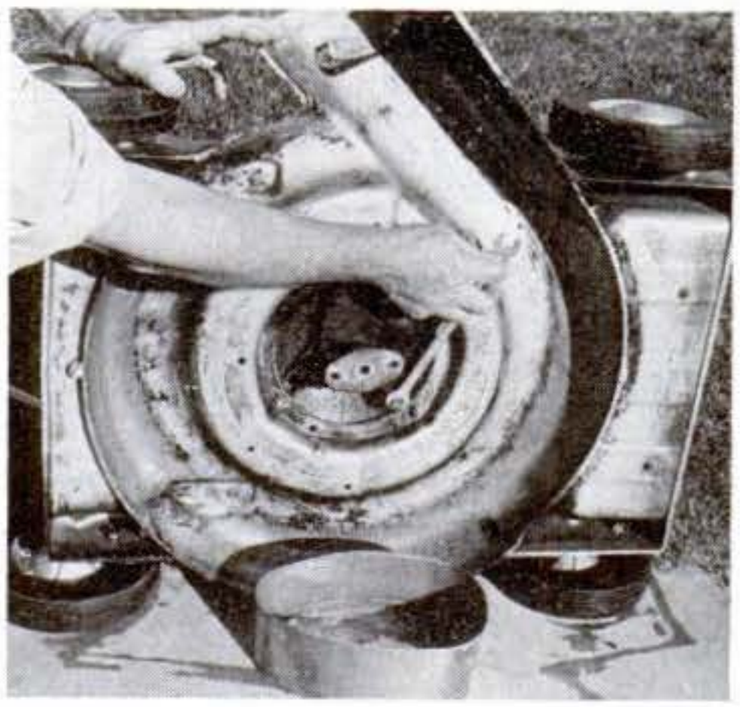
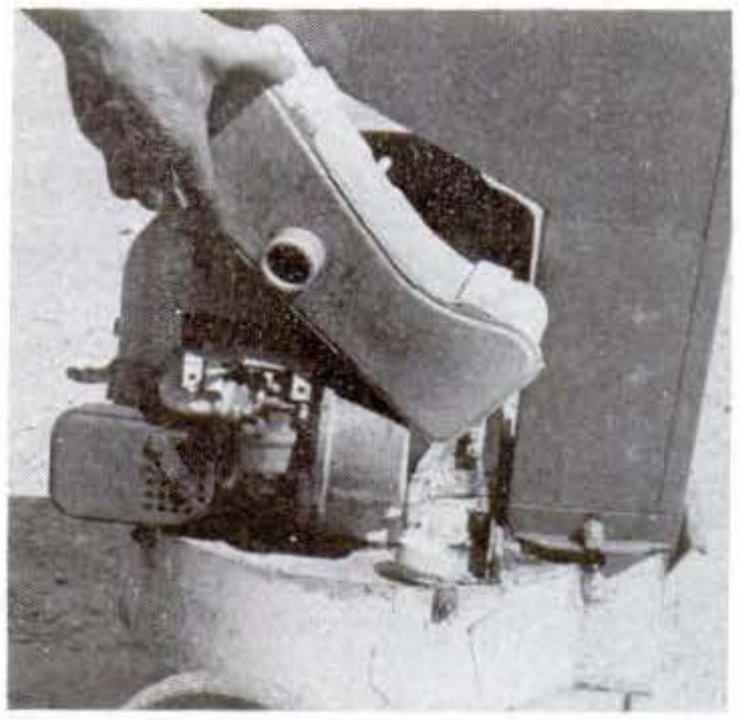
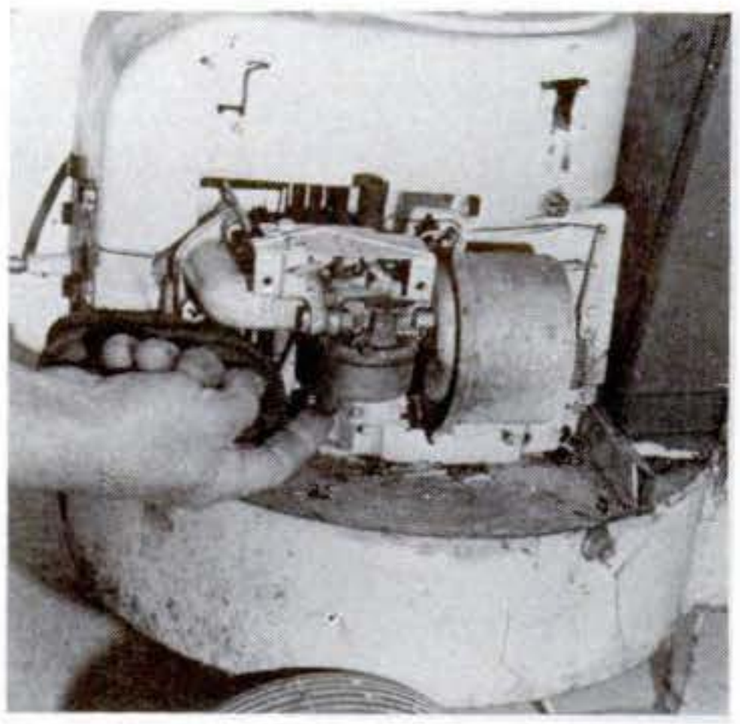


Location of oil drain on rotary mowers is typically unhandy: Blade must be removed to get to it. Using it, however, gets rid of sludge better than by draining through filler. Turn mower over shallow pan to drain.

Light engine oil will help prevent cylinder rust if you squirt or pour a little in and pull starter rope a few times to distribute. Overdoing it may foul plugs and cause starting problems next spring.



Plastic tanks often have slip-in mounts. To drain, just lift and tip. To replace, be sure fuel line mates over carb inlet.



Pushbutton gas drain is under float bowl on many carburetors. Use it to drain carb and to vent air before startup.

cool before you begin to clean it. Cold water applied to a hot engine could crack the metal. Also, some degreasers are flammable and could cause a fire. *Never* immerse engine- or motor-powered equipment in water.

General-care procedures

Thoroughly clean the outside of the tool. Scrape off accumulations of dirt, dried grass clippings, and other debris with a wooden stick or a plastic scraper. Use a ¼″ pointed wooden dowel to reach into narrow places.

Remove the remainder of the dirt and other foreign matter with a stiff-bristle (not wire) brush, a rag, and a solution of soap and water. Remove stubborn grease and oil with a degreaser (denatured alcohol works well). Do not use gasoline, turpentine, lacquer thinner, paint thinner, or dry-cleaning fluid on plastics. Many household cleaners also can damage plastics. Let the equipment dry thoroughly.

Remove any rust or other corrosion, using fine sandpaper or steel wool. Apply touchup paint or machine oil.

Place a drop or two of oil on wheel bushings (do not lubricate plastic bearings), drive chains, drive bearings, linkage rods, straps, and other pivot points. If there is a chain drive, check its case for proper oil level; add additional SAE-30 oil, as required.

Tighten all nuts, bolts, and screws. Also see that all toe guards, safety switches, and chute deflectors are in place and in good condition.

Apply a light coating of automobile wax to painted metal and plastic parts and buff with a soft dry cloth. The wax helps protect the surface and prevents accumulations of dust and dirt.

Beyond the general cleaning and corrosion-proofing that all tools need —even hoes, rakes, and shovels—there are specific before-storage maintenance procedures that differ, depending on the power source of the tool.

Gasoline-powered equipment

Four-cycle engines only: Run the engine until it reaches operating temperature; this heats the oil and sludge in the crankcase, enabling more complete drainage of engine oil. Turn off

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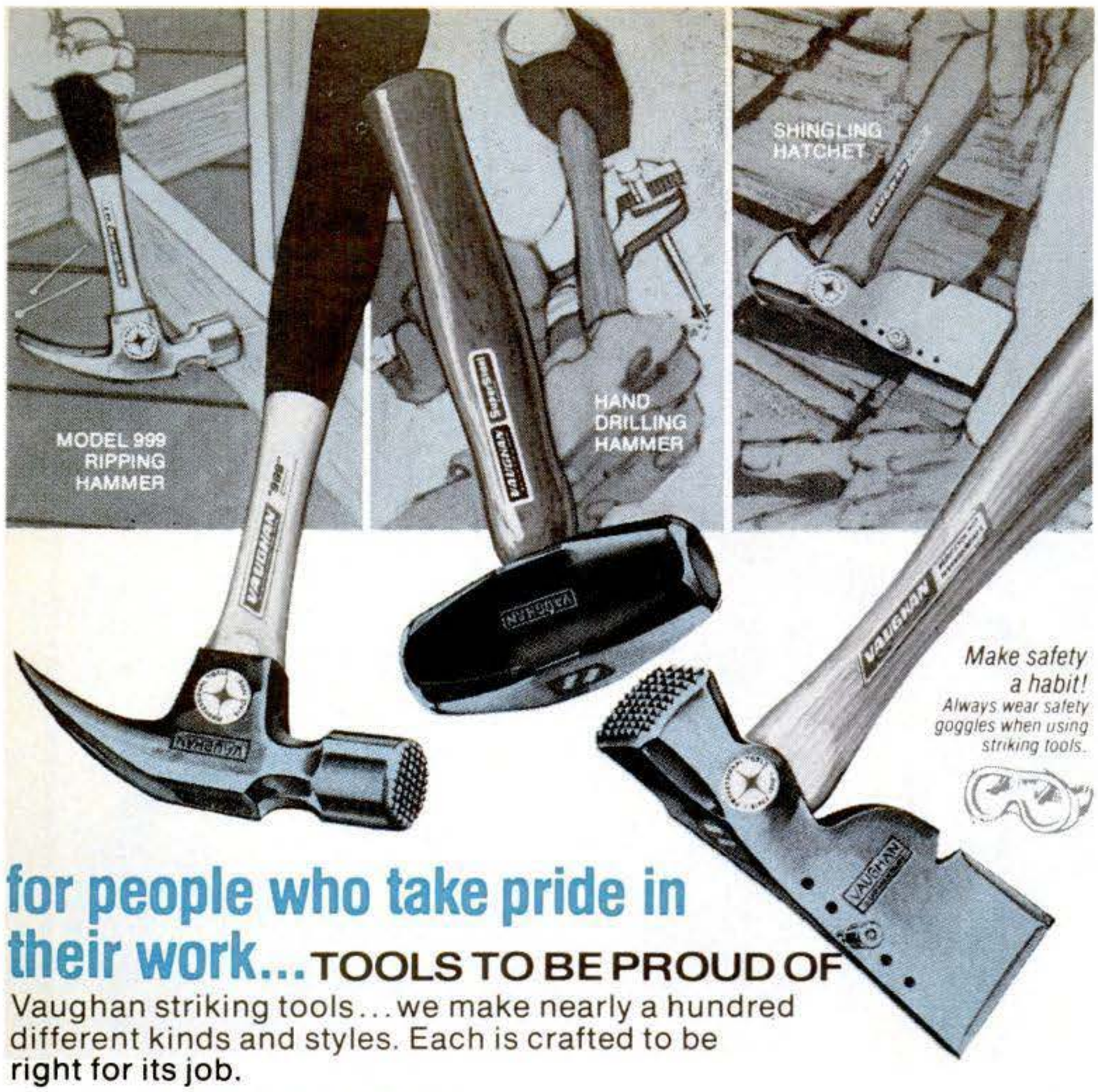

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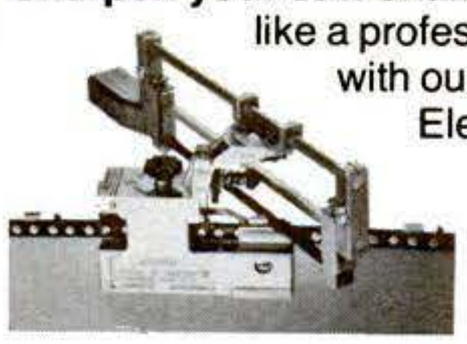

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the engine and remove the high-tension lead from the spark plug. Remove the drain plug and drain the oil from the crankcase (see photo for rotary-mower procedure). Loosen the oil-fill cap to serve as an air vent. After the oil is drained, replace the drain plug. Fill the crankcase to the full mark with new oil and replace the oil-fill cap. Run the engine briefly to bring oil into contact with the working parts, then let the engine cool.

All engines: Stored gasoline becomes gummy and can clog the carburetor and ports within the engine, so drain all fuel from the fuel tank; a pump-type siphon works well for this. Carefully dispose of any gasoline that won't be consumed in the next month.

Start the engine and let it run at idle speed until it stops. Repeat until the engine will no longer start. This burns the residual fuel in the carburetor and lines. Remove the spark plug and pour or squirt about one tablespoon (for engines under three hp) of engine oil (SAE 10W-40) into the combustion chamber. (Use two tablespoons for three to five hp, three tablespoons for larger engines.) Turn the engine over manually through several cycles to distribute the oil. Replace the spark plug, but do not reconnect the high-tension wire; this prevents accidental starting.

Loosen the tension on any V-belts. This is usually done by moving the engage control to the disengage position. If necessary, remove the belt from one pulley.

If the engine starter is battery-powered, charge the battery as explained under "Battery-powered equipment."

Electric-powered equipment

Turn off the power switch and disconnect the cord before doing any maintenance.

Check your owner's manual for the manufacturer's directions regarding motor and bearing lubrication. Some motors are permanently sealed and re-

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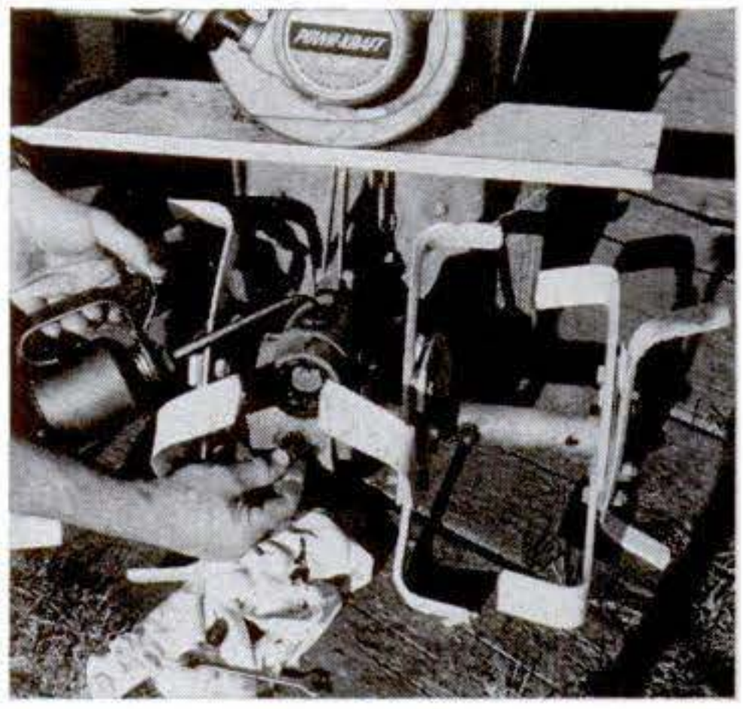

Transmissions and gearboxes differ, but most require lubrication. Check owner's manual for right kind; fill to mark. Clean around plugs thoroughly first so that dirt won't fall into gears.

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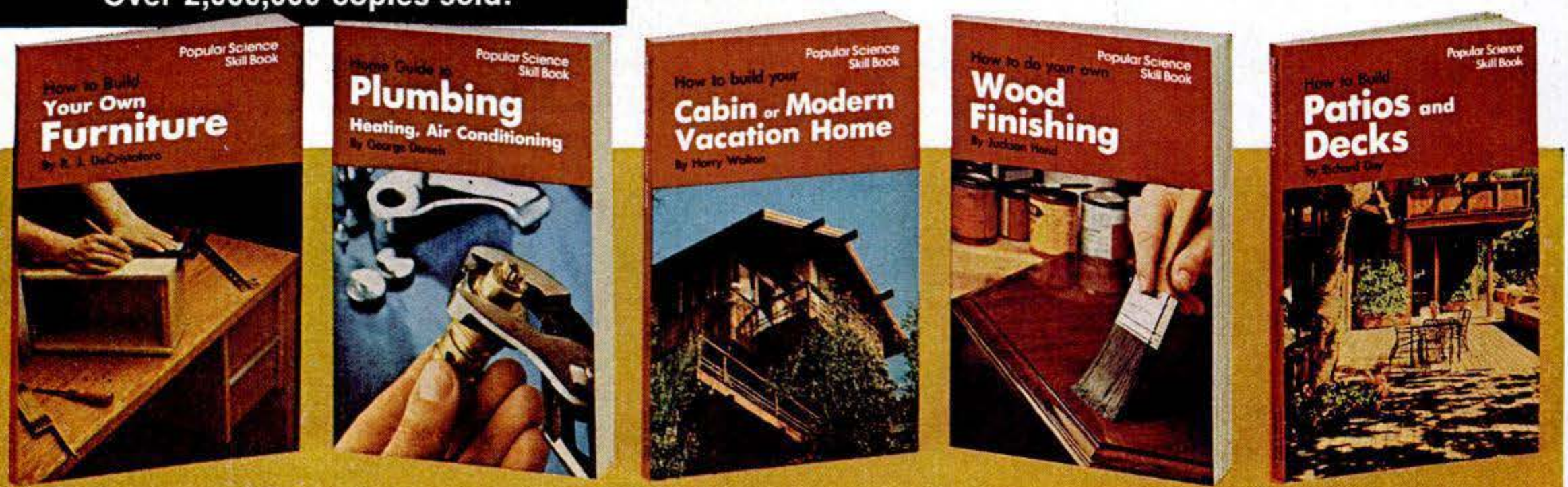

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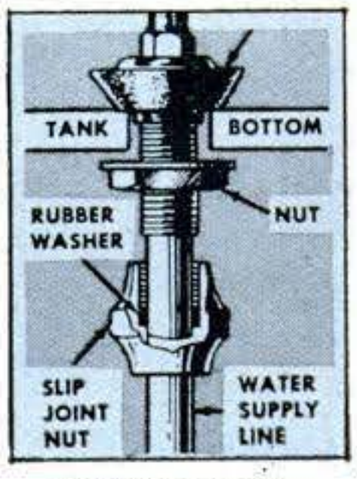

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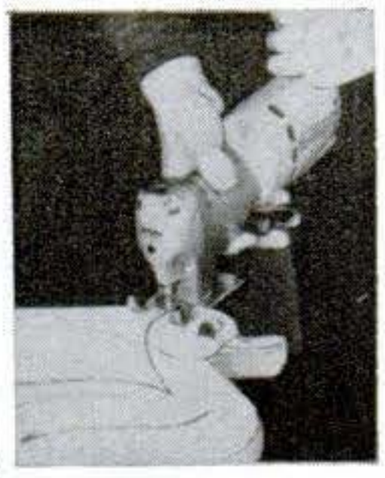

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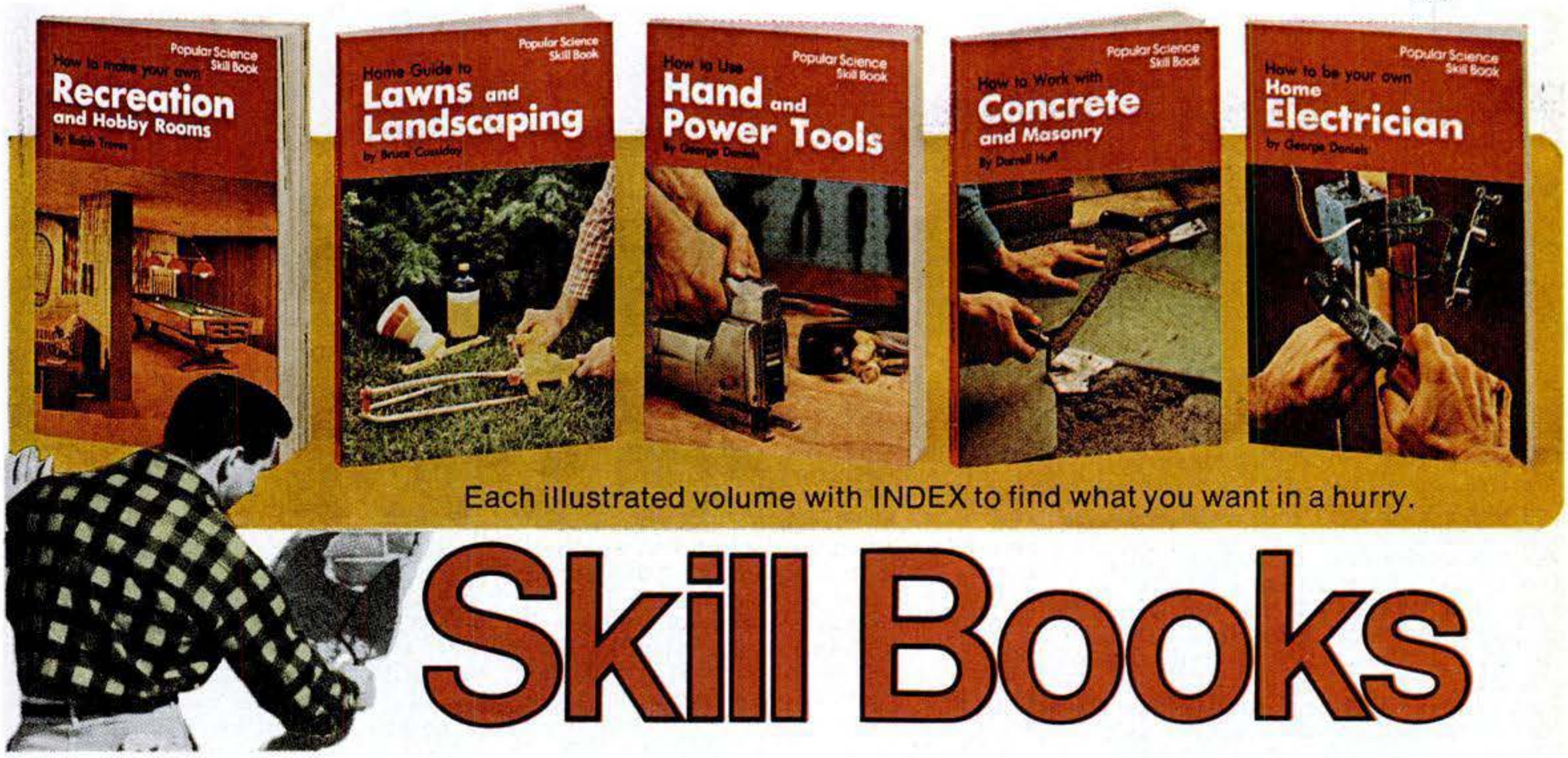

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HENRY MORGAN SAYS:

"Good appliance repairmen are scarcer than doctors who make house calls."

Did you know that there are over a billion appliances in use in the United States today? And three repairmen. At least that's the way it seems when one of mine goes on the blink. With more than two dozen electrical gadgets in my house going snap, crackle and pop, I finally got tired of trying to locate a guy with enough ambition to take my money and I decided to learn how to make the repairs myself.

When a well-aged comic like me decides to go back to school, you can bet the family jewels it won't be back at P.S. 93. I'm going to learn at home, or not at all. So I sent away for NRI's home study course in Appliance Repair . . . and I took the course.

With a mechanical aptitude slightly below that of King Kong, I needed a course that started at the beginning and didn't move ahead too fast. Well, NRI did just that. They started with electricity—what it is and what it does—and went from there. You proceed at your own rate of speed. Whip through it if you want to, or take your time. What counts is the fact that you learn, in a way that it sticks with you.

You learn two things: how to repair appliances—from little one cylinder gas engines to refrigeration and air conditioning equipment; and how to get started in your own appliance business. That can mean money for you either way. If NRI can turn old ten thumbs Morgan into a reasonable facsimile of a repairman, think what they could do for you!

NRI's no fly-by-night outfit. They've been training men for more than sixty years . . . and they've had over a million students. It's the oldest and largest home study school in the field of electronics and electricity, so they know it better than anyone else around.

The NRI course is really easy to understand . . . with lots of pictures to show you what they're talking about. They even send you a professional appliance tester at no extra cost.

With the tester and a few basic tools you probably have already, you're ready to service most electrical appliances. After a few months, you'll be fixing your own appliances like I do, or you can start earning spare time money fixing them for your friends and neighbors. Before you know it, you can have your own full-time business and be independent.

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Yard-equipment storage

[*Continued*]

Batteries on mowers and tractors should have clean tap water added to FULL mark. After adding water, charge to mix water with electrolyte. Fresh water, unmixed, can freeze during cold-weather storage.

quire no lubrication. If your motor requires lubrication of the upper motor bearing, remove the motor cover and place five drops of machine oil (SAE-20) in the felt reservoir at the top of the motor. This is also a good time to check for worn brushes (see photo).

If required, lubricate the blade-shaft bearings located under the deck. Clean the area around the two oil-reservoir screws, then fill the reservoirs with machine oil and replace the screws.

Inspect your power cord; if there are any nicks in the insulation, wrap the areas with electrical tape. If the insulation is frayed near the plug, cut off the bad section and replace with a UL-approved plug. Rotate any V-belt-driven blades by hand every 30 days during storage. This helps prevent the belt from taking a "set" where the belt contacts the pulleys.

Battery-powered equipment

Add clear water to the battery to bring the electrolyte level to the FULL line. Replace the vent plugs securely.

Charge the battery fully: A discharged or partially charged battery may freeze and burst. During charge, batteries can be left on the equipment or removed. Do not attempt to remove batteries from tractors and mowers that have four or more batteries unless the support structure requires cleaning and painting. Charge batteries according to your owner's manual.

Check battery charge every 30 days

Continued

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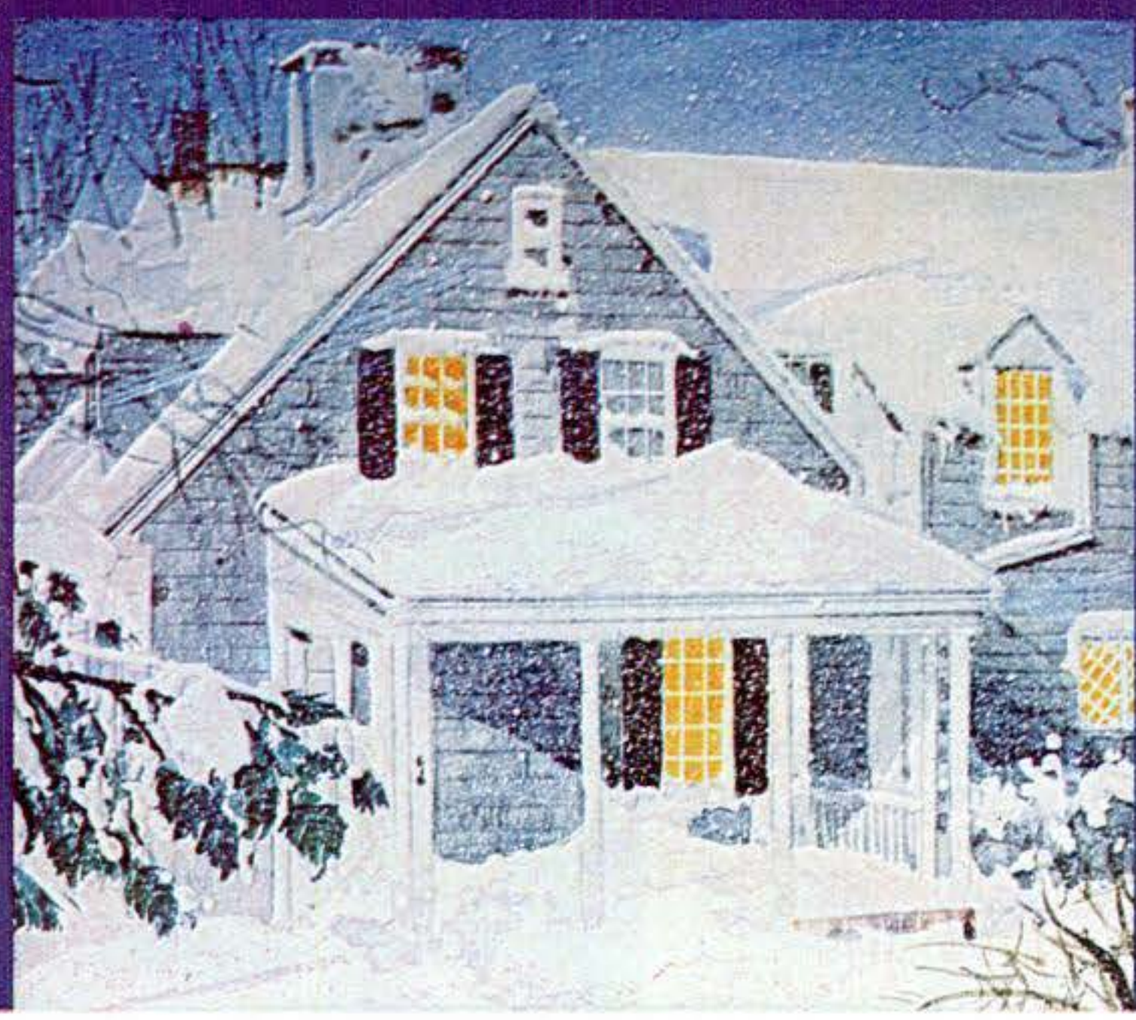

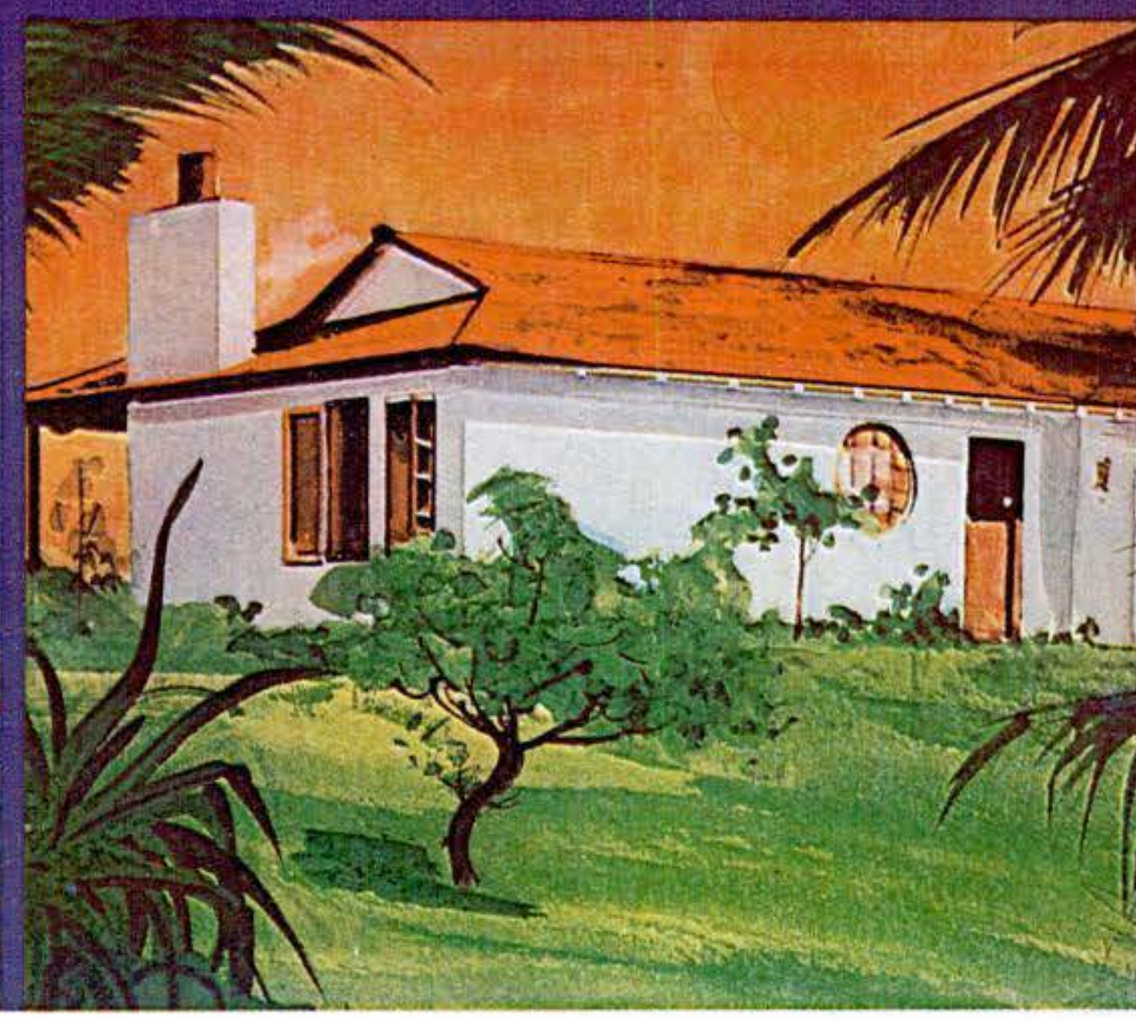

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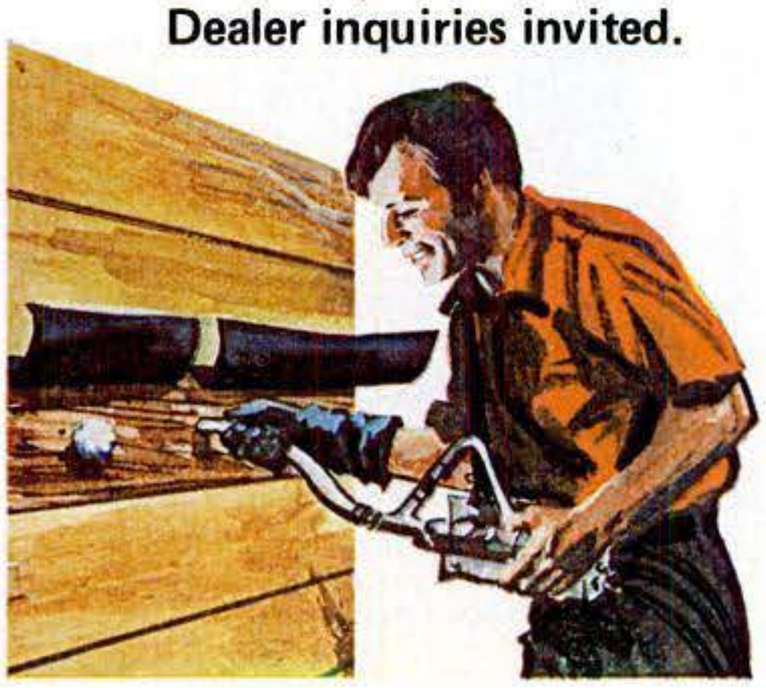

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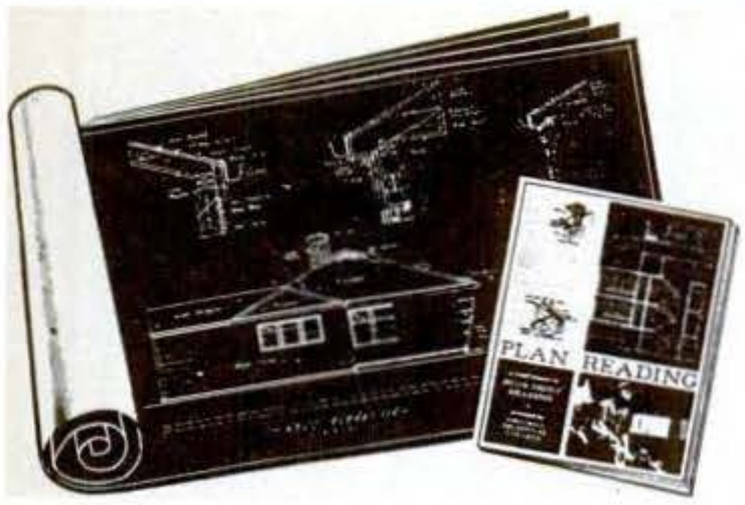

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Yard-equipment storage

[Continued]

during storage, and recharge if necessary. Recharge at least every three months (every two months is better at low temperatures). If the charger operates on a timer, charge until the end of the charging cycle. Do not leave the battery on maintenance charge during extended storage unless manufacturer's instructions recommend it.

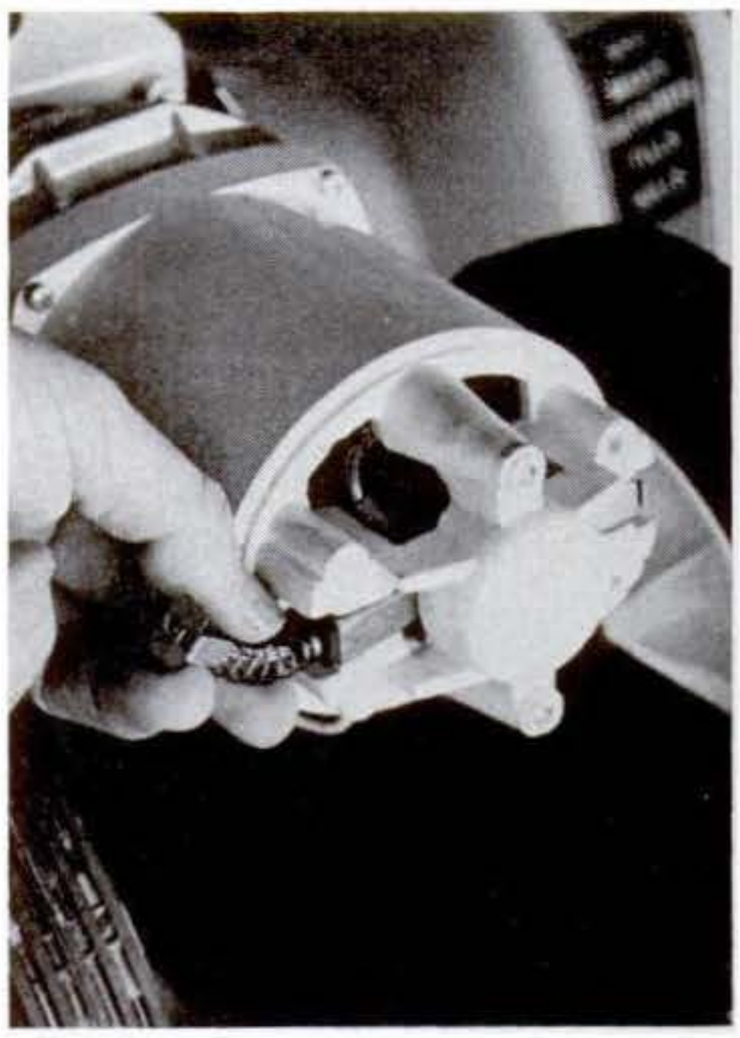
Clean the battery with a mild solution of baking soda and water; be sure the vent plugs remain tightly in place. Brush on the solution and allow it to work a few minutes, then rinse off with clear water and dry the battery.

Clean the battery terminals and connections with a wire brush or steel wool. Wipe away any foreign matter with a clean, dry cloth.

Store the battery in a cool, dry place away from furnaces and water heaters. The battery can be left on the equipment or stored separately.

Continued

Clean battery-powered shearer blades with detergent and rinse in a pail of water. Immerse cutting parts only and run until gook and soap are removed. Dry and spray with non-oily lube such as silicone.



Check brushes on electrical-drive machines. Most are easy to remove and replace once you've removed the motor end cover.

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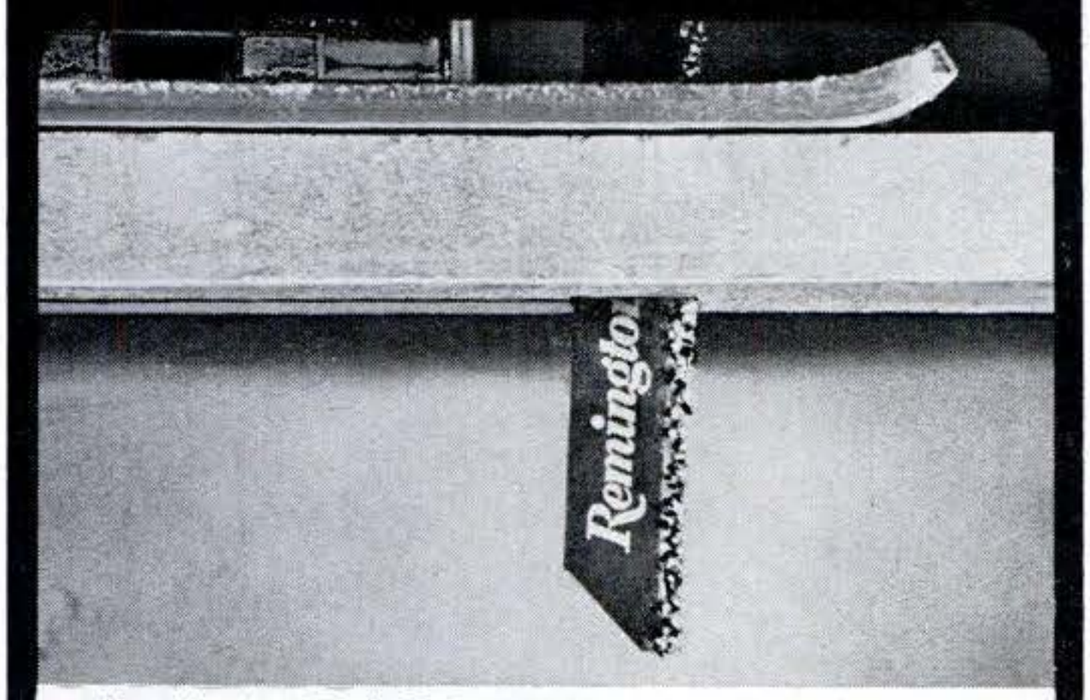

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Beryllium	X	X			X
Carbon	X	X		X	X
Cast Iron	X	X			X
Composites	X	X	X		X
Composition Board			X	X	X
Fiberglass	X	X	X	X	X
Foamed Glass	X	X			X
Friction Materials	X	X	X	X	X
Glass	X	X			X
Hardened Steel	X	X			X
Honeycomb Materials					X
Marble, Natural	X	X	X		X
Marble, Synthetic	X	X	X	X	X
Plaster			X	X	
Plastic Laminates	X	X	X	X	X
Plywood			X	X	X
Stainless Steel	X	X	X*		X
Stranded Cable	X	X			X
Superalloys, Iron-base	X	X			X
Superalloys, Nickel-base	X	X			X
Tempered Hardboard			X	X	X
Tires, Steel-reinforced					X
Titanium	X	X			X
Tile, Ceramic	X	X	X		X

*Requires coolant and variable – speed machine

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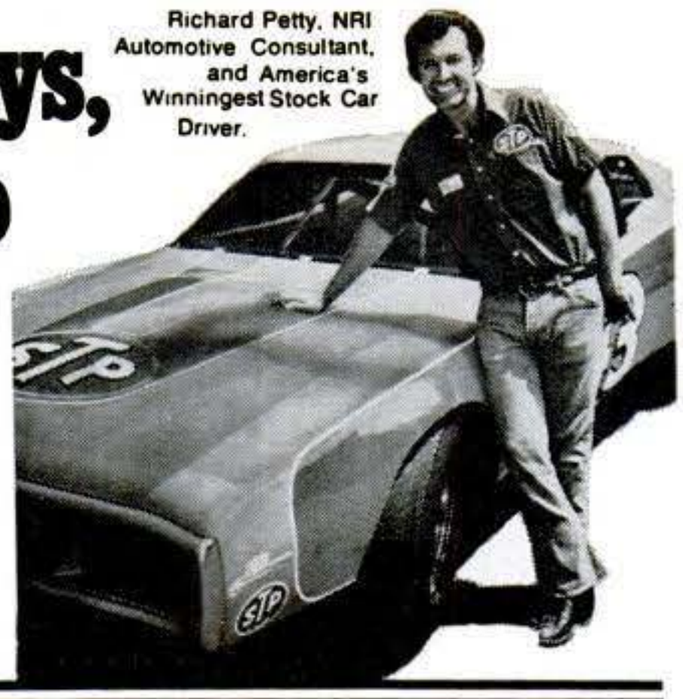
Richard Petty says, "If you really want to learn how to repair cars, check out NRI home training."



Richard Petty, NRI Automotive Consultant, and America's Winningest Stock Car Driver.

They give you all the training and equipment you need to get you started in a hurry.

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Yard-equipment storage

[*Continued*]

If it is stored on the equipment, keep the power disconnected. Fully charged batteries on electric mowers and tractors can be safely stored outdoors or in an unheated building.

If motors on your equipment require lubrication, unplug the battery and remove the motor cover. Place four drops of SAE-20 motor oil in each screw hole. Replace the cover and tighten screws.

If your machine has a gearbox transmission, check the lubricant level and service according to the owner's manual.

Battery-pack equipment

Charge the battery pack fully when the ambient temperature is about 75° for best performance and longest life. Charging when the temperature is below 40° F or above 105° F could damage the pack.

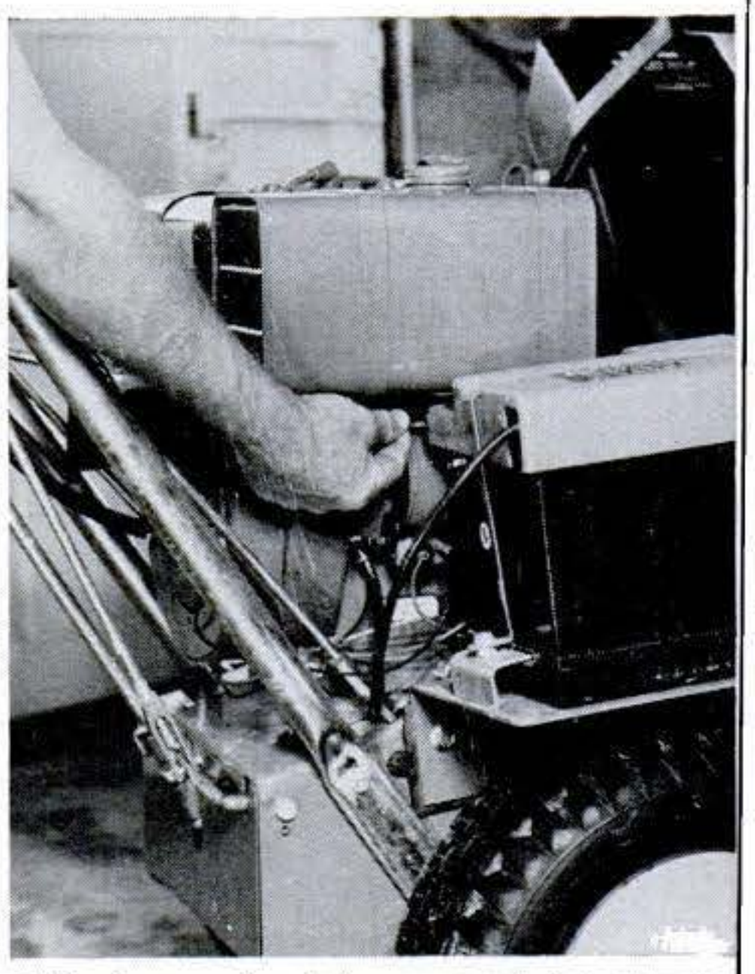
Clean blades and rinse as shown in photo.

Store the tool, charger, and energy pack in a cool, dry place; the best storage temperature is 50° F. The pack can be stored for several years at this temperature without recharging.

Where to keep tools

Store your equipment in a cool, dry place, preferably indoors. Do not store it close to fertilizers or other garden chemicals; they may contain agents that greatly accelerate the corrosion of metal. Engine- or motor-powered equipment should be wrapped in a clean shroud, such as an old blanket, and stored on a level surface.

If you follow these preventive-maintenance steps, your lawn and garden equipment will be just about ready to roll next spring. Only a few minor DIY procedures will put it all in operation. We'll tell you what they are in a spring issue.—*George R. Drake*



Batteries need not be removed for storage, but if you do so, or if you're going to clean connections, shut off gas. Be sure fumes are gone: Spark could cause a fire.

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brings you more of the newest and more of the most comprehensive selection of solid BRONZE, antique BRASS and PEWTER finish Buckles along with our newest Hand Enameled belt buckles for the brand new **78** SEASON

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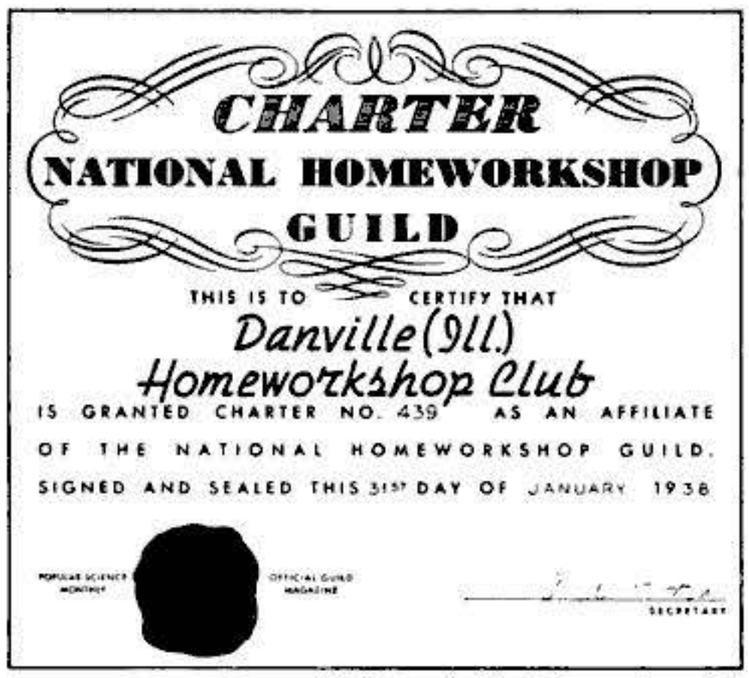
SHOP TALK

By AL LEES


CHARTER
NATIONAL HOMEWORKSHOP GUILD
THIS IS TO CERTIFY THAT
Danville (Ill.) Homeworkshop Club
IS GRANTED CHARTER NO. 439 AS AN AFFILIATE
OF THE NATIONAL HOMEWORKSHOP GUILD.
SIGNED AND SEALED THIS 31ST DAY OF JANUARY 1938
POPULAR SCIENCE MONTHLY
OFFICIAL GUILD MAGAZINE
SECRETARY

Remember the Workshop Guild?

As I mentioned here in August in connection with our plywood-projects contest, one of the rewarding aspects of my job is contact with amateur craftsmen—and few such contacts have been as delightful as this recent letter:

"I enclose a copy of the 1938 charter certifying our Homeworkshop Club as an operating unit of the Guild sponsored by Popular Science. This was the beginning of the Danville Club, which has just celebrated its 40th year of continuous, active, enthusiastic, profitable operation.

"We feel this could be a record for Homeworkshop Clubs and would like to exchange correspondence with other clubs.

"Over these many years we have revised our constitution and bylaws to maintain what we consider to be a practical, workable club. Aside from the personal satisfaction each member receives from sharing skills with his peers, we have devoted considerable time to varied civic projects (building a Boy Scout camp, for one); we've contributed much to the community and established an enviable reputation for the club." The letter is signed by club president Eldon G. Dombroskie.

No matter how long one works for a magazine that has been published every month for over 105 years, one must accept the fact that some things predate one's tenure. And I confess the National Homeworkshop Guild was new to me. I checked with a few staff members who've been here even longer, but none could remember what connection PS had with such an organization.

So, naturally, I sought out the dean of home craftsmen, Arthur Wakeling, who held my job here in the '30's and was instrumental, much later, in my coming to PS. Arthur is long retired, but his interest in and promotion of workshop activities has never flagged. Nor has his remarkable memory. He promptly supplied me a bibliography of the dozens of features he ran on the Guild from the announcement of its formation [PS, Dec. '33] up until the start of WWII.

It's appropriate that my belated introduction to the Guild should come through an Illinois affiliate, since the Guild itself, Arthur tells me, was the outgrowth of a successful workshop club in Rockford, Ill. To support their movement, the Guild chose PS as official organ and appointed Arthur to its board of directors.

As Guild membership mushroomed, administrative chores became too much for the Rockford founders, so they turned the project over to PS, which sponsored a major national exhibition of members' projects in Chicago in the spring of 1935. Arthur persuaded Rufus C. Dawes, president of Chicago's famous Century of Progress world's fair in 1933, to be head judge. The event was widely hailed as the finest display of woodcraft and furniture projects (over 1000 items) ever assembled. "It was a glorious week for home workshoppers!" Arthur recalls.

By 1939 the Guild boasted a membership of over 500 clubs, coast-to-coast, but activity declined quickly after Pearl Harbor. "A very difficult period," Arthur reminds me. "In the case of my own club, younger members went into service, others had war-work jobs with overtime that ate up their leisure—and none of us could keep up with club meetings, what with duties as air-raid wardens and the like."

The Danville Club, however, persisted and still flourishes. We're as curious as President Dombroskie: Is it the oldest surviving remnant of that glorious Guild? Other clubs can contact Dombroskie at 102 Fairweight St., Danville, Ill. 61832.

Check your ducts this month

As a footnote to last month's article, "Insulation Upgrade" [p. 144], reader W. V. Sayner, Jr. writes from Sunnyvale, Calif.: "My experience suggests you're right to direct the attention of your energy-conscious readers to their heating ducts. As in many U.S. homes, my ducts are in a crawl space under the house. Toward the end of last winter, jolted by my fuel bills, I crawled under to inspect the ducts and found that through the years they'd become loose and had actually separated in several places. Expensively heated air was escaping into the crawl space. After getting them resealed, I decided that the ½" original insulation resulted in considerable heat loss, too, so I added another 1½" of fiberglass. From that moment, my furnace kicked on about one-third as often as before. I'm facing the coming heating season with much less trepidation."

Don't give up spackling

First the Feds grab your saccharin and now they want to wrest your spackling compound from you. Don't give an inch: What they're after are patching powders and pastes that contain asbestos fibers. The Consumer Product Safety Commission believes that inhaling such fibers can cause cancer and points out that fibers in *dry* compounds can become airborne while you mix them with water. With ready-mix pastes, the danger comes after the application dries and you scrape or sand the patch smooth.

Our point is that, although *half* of all patching compounds now sold contain asbestos, many do not.

United Gilsonite Laboratories writes us from Scranton, for example: "Long before the Commission voted to ban the use of asbestos in wall-patching compounds, we'd removed it from such products, replacing it with nonharmful minerals. Our home-repair products that contain no asbestos include 222 Spackling Paste, UGL Spackling Compound (dry), Joint Cement, Wood Putty, Crack Filler, Plaster Patch, and Tile Grout."

Another well-known brand that's "safe" is Elmer's Redi-Spack, an acrylic-latex paste that's asbestos-free. Most patching compounds that are safe make no secret of the fact on the label. But compounds that do contain asbestos seldom say so. It's bound to become an academic question soon—perhaps by the time you read this—because the Commission plans to prohibit all manufacture and sale of asbestos patchers 30 days after it publishes its final ban in the Federal Register.

New DIY literature

- If you work with acrylic sheet, you'll want a 12-page brochure describing the physical properties of new Acrylite FF, including its excellent optical quality and thickness control, its easy handling characteristics and resistance to chemicals. Request Bulletin AST 609 from Communications Dept., CY/RO Industries, Berdan Ave., Wayne, N.J.
- Two new construction books that impressed me: *Housebuilding for Children*, by architect Les Walker (who's designed many projects for PS) is a charming, lavishly illustrated book that shows a group of seven-to-10-year-olds building six different houses with some skill, minimal supervision, and much enthusiasm. The book is ideal for any parent or teacher with preteens to keep busy. It's $10 from Overlook Press, c/o Viking, 625 Madison Ave., New York, N.Y. 10022. *Build It Better Yourself* is an awesome compilation (941 pages) of basic how-to for the homesteader, from the editors of *Organic Gardening*. It's virtually an encyclopedia of projects and data related to gardening (indoor and out), food storage, fences, gates, and outbuildings. Plans are clear and complete, with materials lists. It's $16.95. Rodale Press, Emmaus, Pa. 18049. PS

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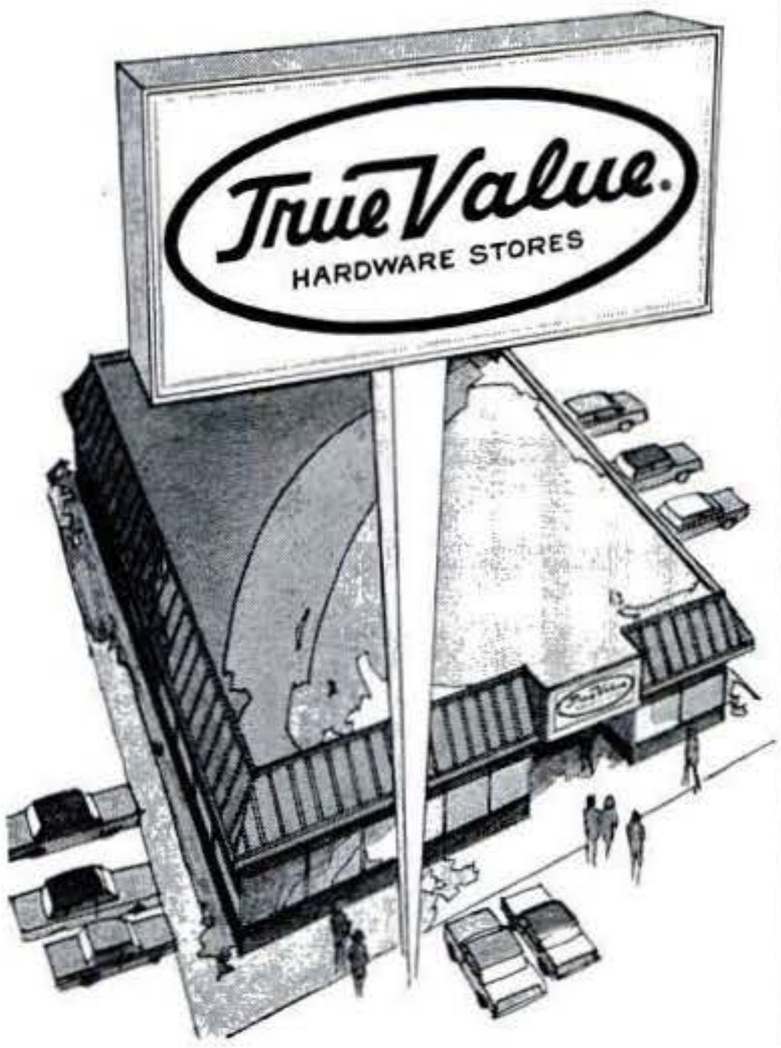

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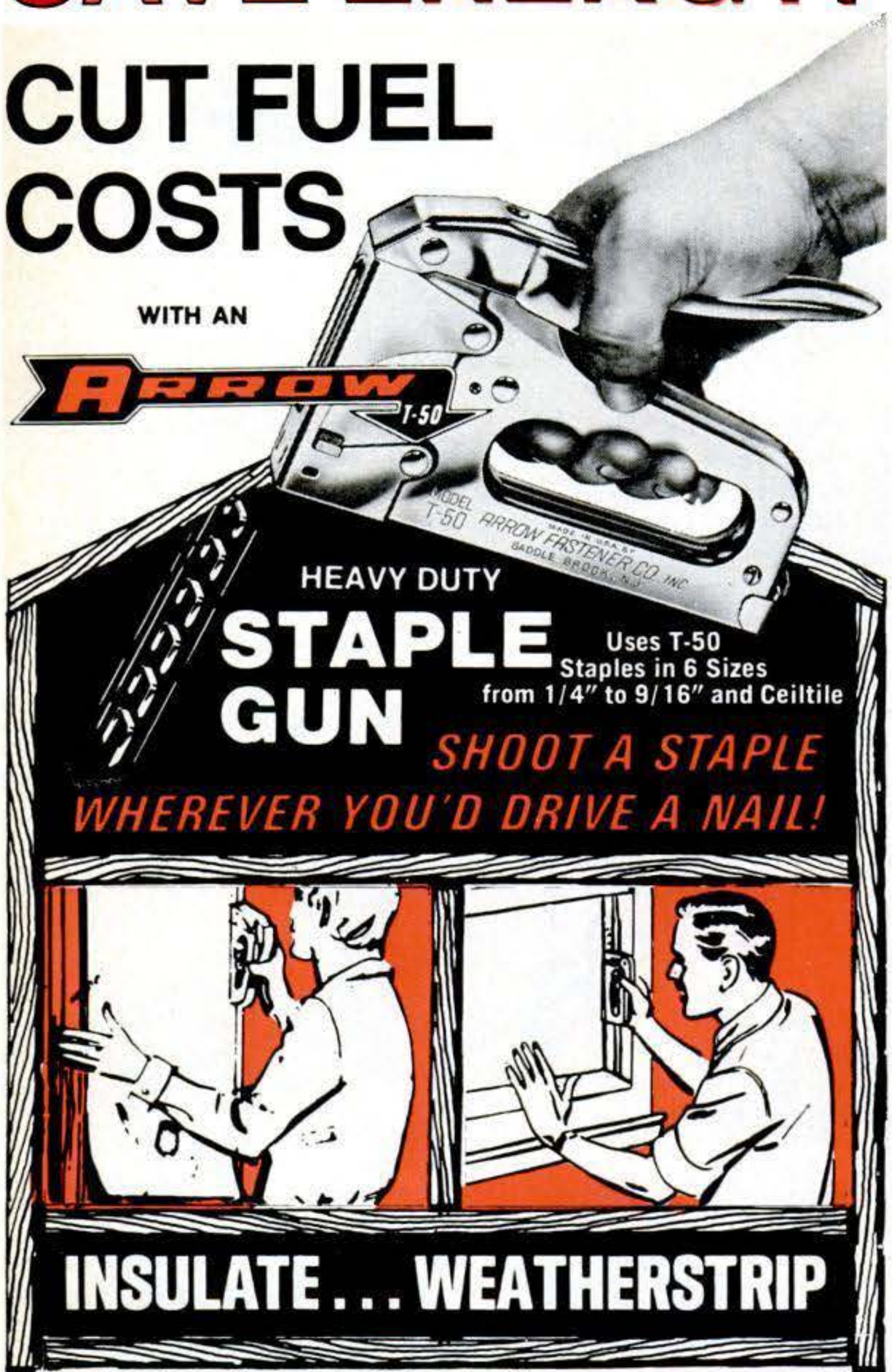

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You'll save up to 30% on fuel bills when you insulate and weatherstrip your house with an Arrow T-50 Staple Gun. You save your own energy, too — as well as labor costs! It's a breeze — one hand does it . . . one SQUEEZE and you've nailed it!

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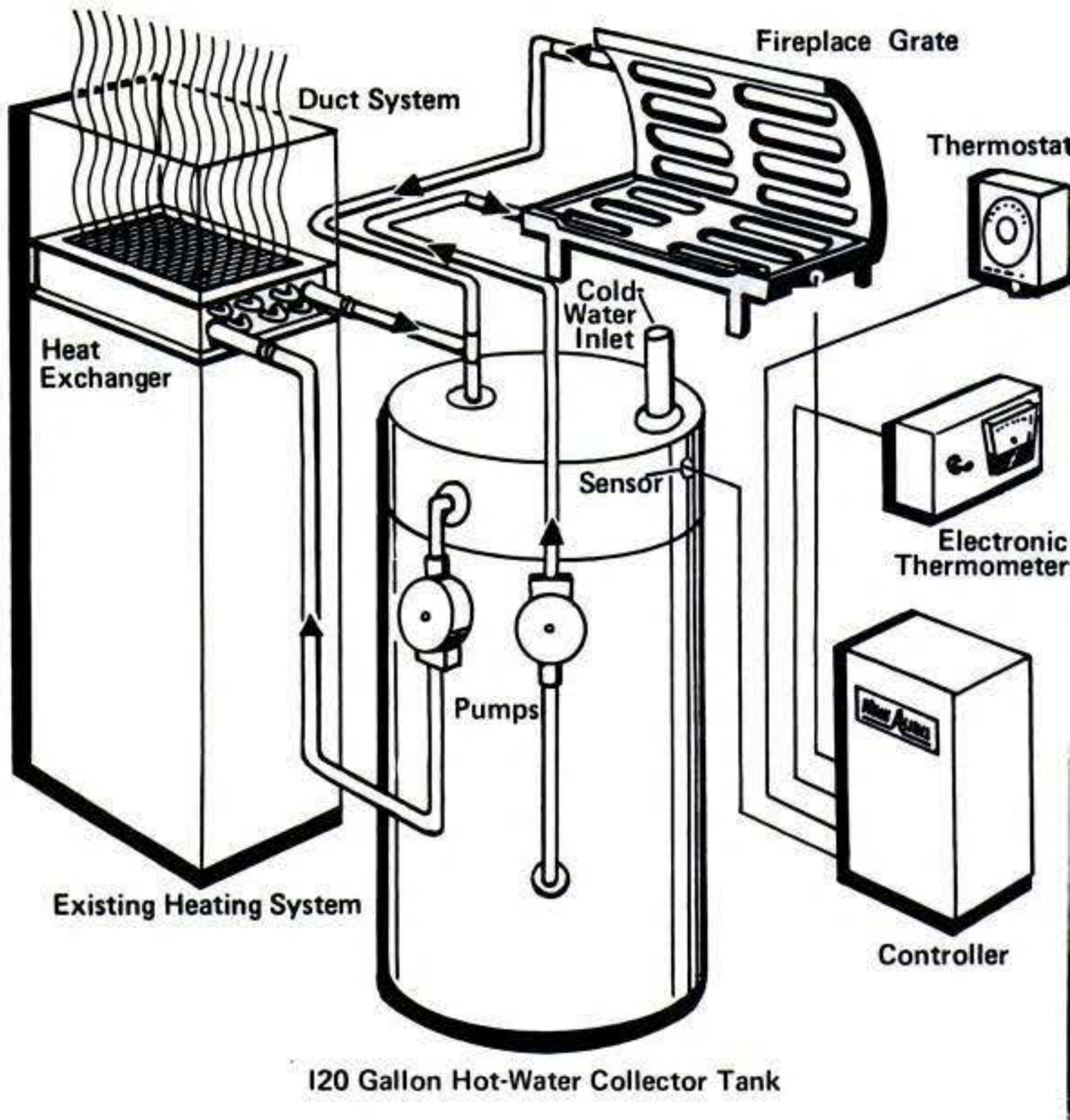

Your fireplace wastes about 80 percent of the heat it produces. It's pulled up the chimney and replaced by cold air suctioned in from the outside.

Southeastern Solar Systems, Inc. (4705-J Bakers Ferry Rd., Atlanta, Ga. 30336) says you can increase efficiency with its new fireplace heat-extraction system—so you use 50 percent of the heat your fireplace produces. The system has a box-channel steel grate that draws heat from the fire. Water pumped through the grate transfers the heat to your existing forced-air or hot-water system. Heat distribution to any or all rooms is controlled by thermostat or blower. Because all of the system's piping is stainless steel or copper, it can also be converted to heat potable water in your home.

Operation of the fireplace system is completely automatic. A sensor detects the fire when it's lit and actuates the circulating pump. When the fire dies down and there's no longer any usable heat, the pump shuts itself off.

Originally designed as a backup for solar-heated homes, the heat extractor is now being offered as a primary heating system. If you're willing to chop a sizable store of firewood, you could save up to 98 percent on your fuel bills, the manufacturer claims. The system collects enough heat in four hours to heat the average home for an entire day.

Total cost of the system is $699, plus installation. Extra piping and labor generally run about $300, but instructions are included for installing the system yourself. It's guaranteed for five years—Southeastern says it should last 20.—*Nancy Smith*

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Great moments in the basement.

Making a shearing cut with a skew chisel may not be everybody's idea of kicks.

But for the man with a shop in the basement, and a lathe in the shop, it's one heck of a feeling.

Probably second only to seeing his own work take shape. An intricate chess piece. A cabriole leg. Or anything else that wood and skill and imagination can turn into something beautiful.

For the man like that, we make the Rockwell 14/11" Gap Bed Wood Lathe. One heck of a tool for $329.99*, for some very good reasons.

A ribbed, one-piece bed with inch-and-a-half, precision-ground ways.

A 14-inch swing over the gap, 11 inches over the bed, and 36 inches between centers.

A ball-bearing headstock, and an adjustable tailstock with a graduated ram.

A built-in indexing mechanism, and a precision-ground universal tool rest.

And four speeds, to handle any kind of wood (and plastic and metal).

All of which make it possible for you to make just about anything imaginable. Symmetrical, elliptical, helical. Beaded, chamfered, tapered. Whatever.

Of course, what goes into this lathe goes into every lathe we make, including our $179.99* 10-inch model. And into our radial-arm saws, table saws, band saws, jointers, drill presses, wood shapers and so on, on down to our 3/8-inch drills.

Real engineering. The kind that makes them unique. The kind that only comes with half a century of experience and on-the-job performance.

What that buys you is as good as you could ever want, short of actually having our big industrial equipment.

Namely, some impressive features, regardless of price. And the three things there are no substitute for in any tool, regardless of who makes it.

Accuracy. Power. Durability. With us, they're not just words. They're a reputation. The stuff that great moments are made of.

You can depend on it.

Rockwell. It's the same name industry's been depending on for 50 years.

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Two-way improvement

Avoid CB radio theft with magnetic mount antenna. Just lift off and lock inside vehicle. Extra-strong magnet has 90-lb. pull.

Has your CB ever let you down? Right when you needed it the most?

It could be that "good deal" antenna. Or the lightweight mike that came with the set. To get the most out of your CB, switch to Turner at both ends.

Try a Turner amplified mike. You'll find out how much talk power your set can really deliver. For full range when you need it.

Make sure your antenna is dependable. Step up to a Turner. Turner builds them tougher. There are 43 models for all kinds of base and mobile installations.

Ask anybody who has been around CB for awhile. They know us. Wherever CB is sold, Turner.

The talk of the road

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MICROPHONES
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CONRAC CORPORATION 716 Oakland Road N.E., Cedar Rapids, Iowa 52402

Atrium house

[Continued from page 125]

It's a two-story house where basic L turns corner: This sleeping loft is tucked in peak over dining area, and becomes a study or hobby space when bedrooms are added. Exposed rafters and tie beams add to rustic charm of living room.

later become a structural part of the final cabin wing. And you end up with a gracious privacy core.

The *utility* core remains the same from the start, so if you plan to go the full distance, you may want to overscale the washer/drier, furnace, and water heater to accommodate the maximum number of occupants these appliances will eventually serve. An exception: That cabin wing would have its own heat.

Note that the second bath is private to the master bedroom. The original bathroom then serves the house itself and any later bedrooms.

"The atrium has been part of domestic architecture from early Roman times," says Ward. "At first it was the central room, with a hearth and a smoke hole in the roof. As the floor plan got more sophisticated, a more formal kitchen appeared and the hearth was moved there. The atrium took on aspects of an unroofed court, often with a surrounding colonnade. It became the center of family life—as ours will." PS

Additional details for $2

Atrium-house study plan, with scaled exterior elevations, section through atrium, dimensioned floor plan, and general materials list for cost-estimating at local prices, is $2. Complete professional working drawings for construction are $40 ($10 for each additional set with original order). These plans include elevations of exterior and atrium walls, full foundation plan, and a progressive materials list that lets you estimate what each stage will cost. All plans sent postpaid by first-class mail. Send check or money order to Idea Enterprises, Box 1720, Grand Central Sta., New York, N.Y. 10017. Specify: Atrium.

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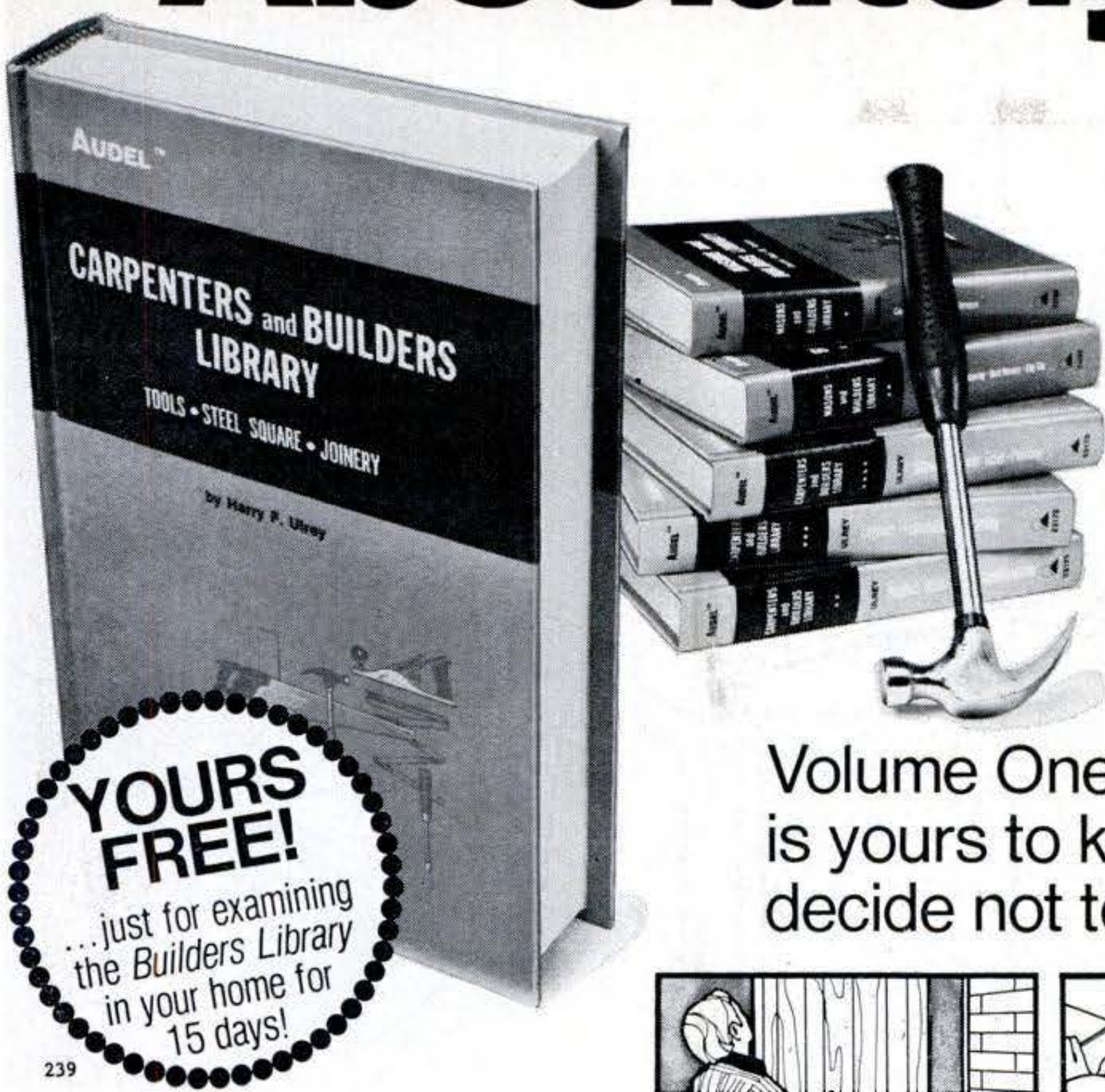

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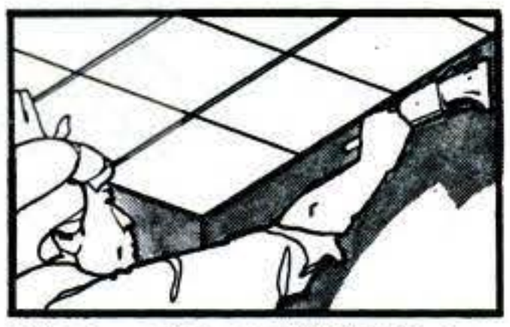
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  Time-saving tips for increasing your home's value by building a fireplace, patio, walkway, or even a barbecue pit.

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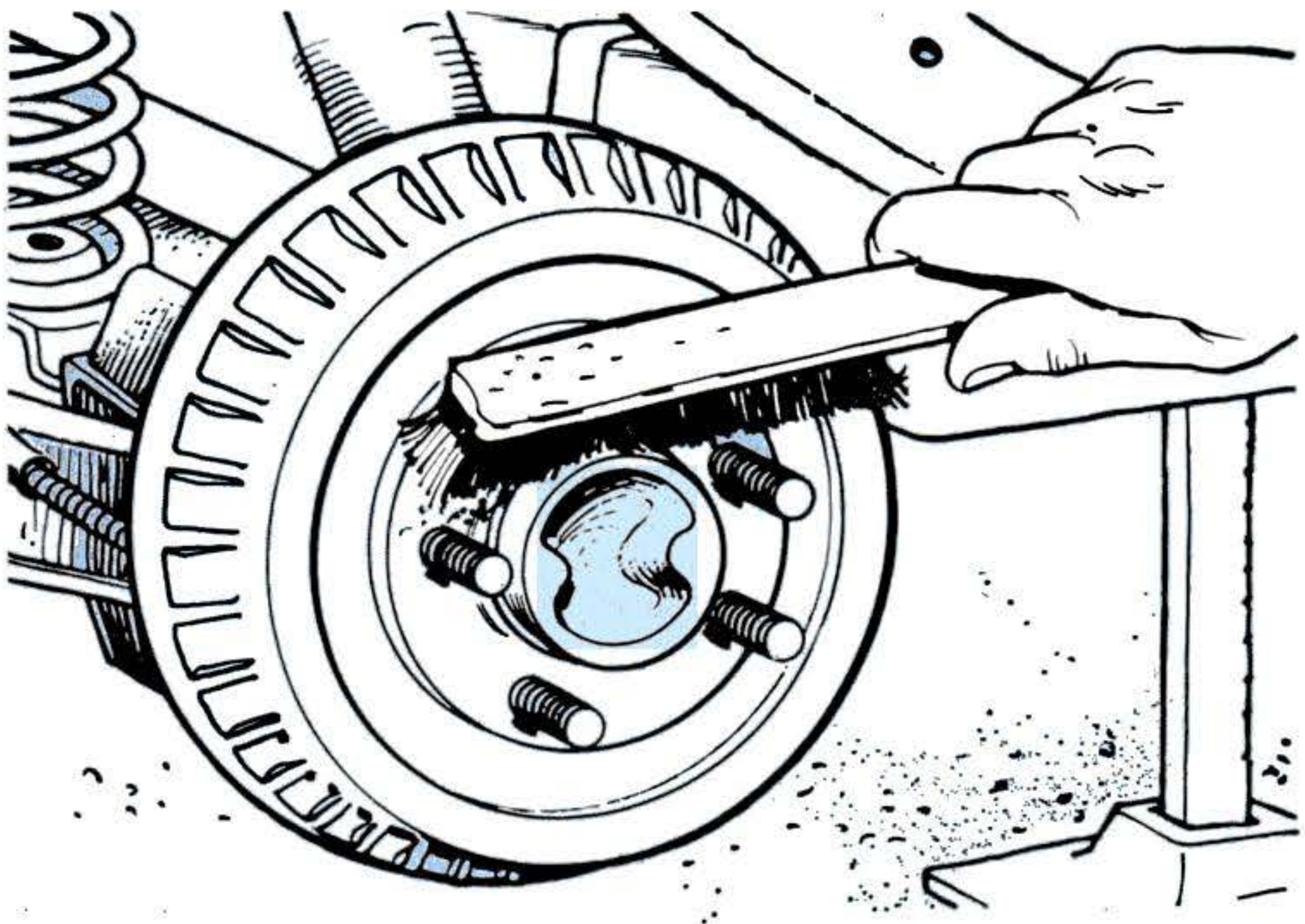
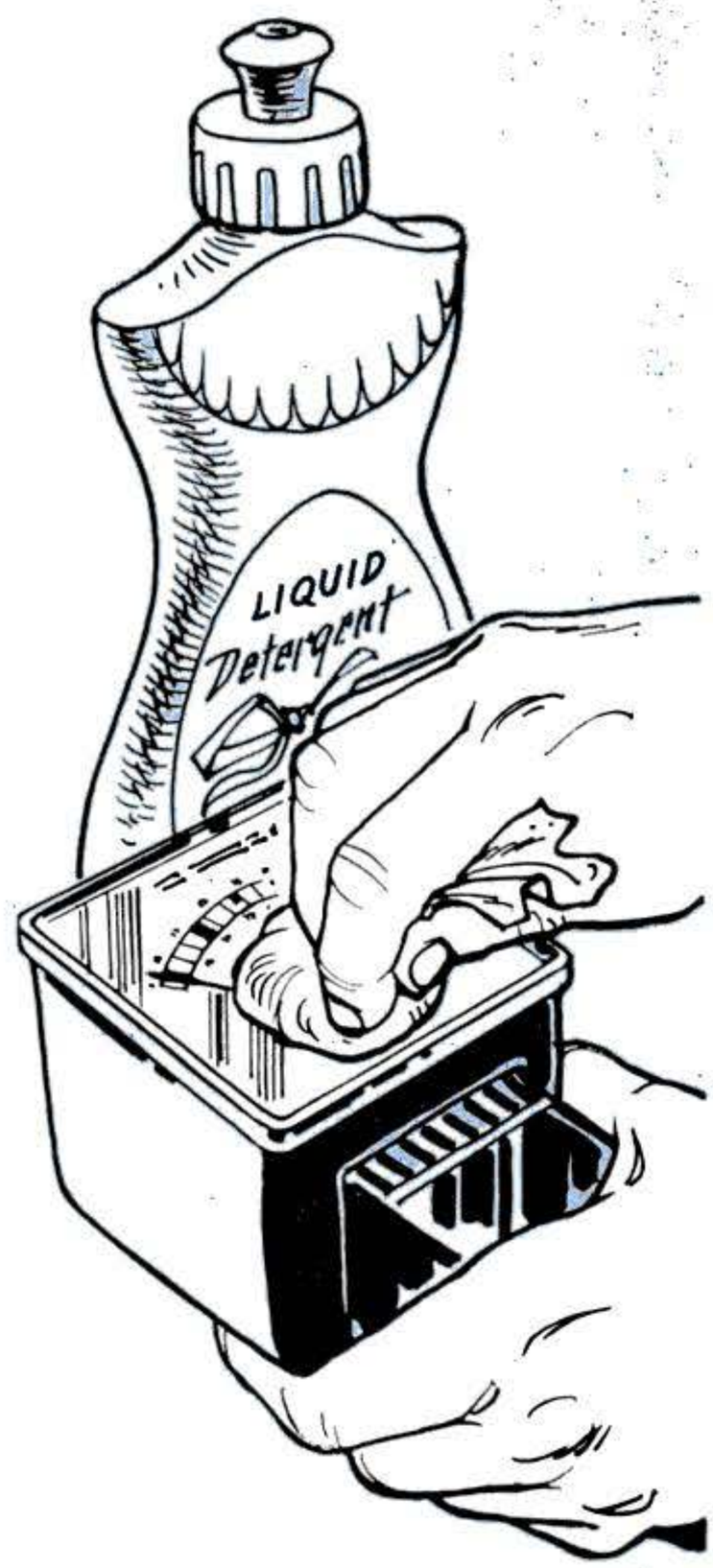
TAKING CARE OF YOUR CAR

By
RICH CEPPOS

Got a useful car tip? Send it (with Social Security No.) to Car Care, Popular Science, 380 Madison Ave., New York, N.Y. 10017. We'll pay you $25 if we use it. If two or more readers send in the same usable tip, the one with the earliest postmark will be chosen. Sorry, but tips can't be returned.



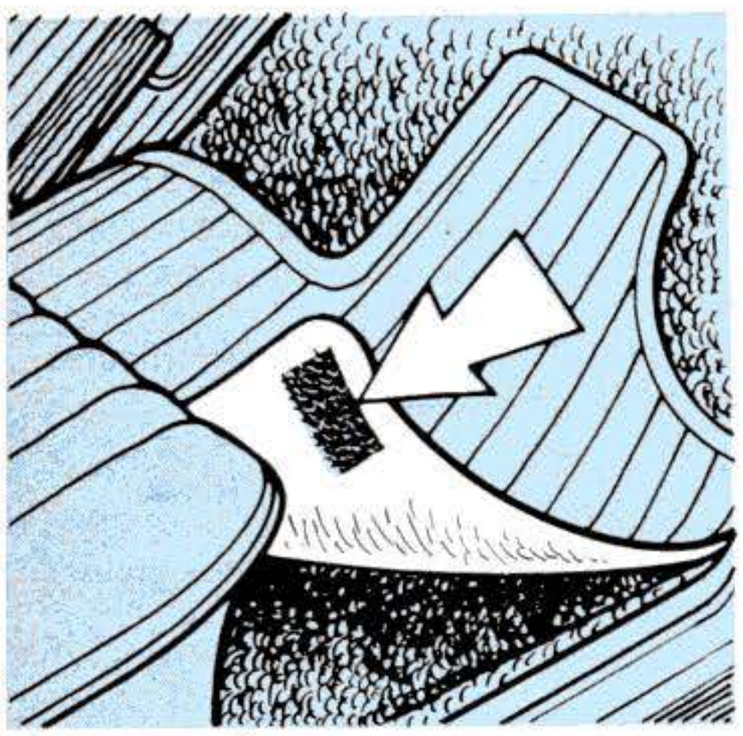


Removing frozen rear brake drums

When rear brake drums are stuck in place, start by tapping the drums gently around their outer edge with a wooden or rubber mallet. If this fails to loosen them, wire-brush the area where the drum and rear-axle pilot meet, as rust at the interface of these two surfaces can cause the drum to stick. Next, try soaking the area around the pilot with penetrating oil. If all else fails, heat the area with a blowtorch and tap the drums gently. Never use a brake-drum puller, as you may chip off a piece of the drum in the process.

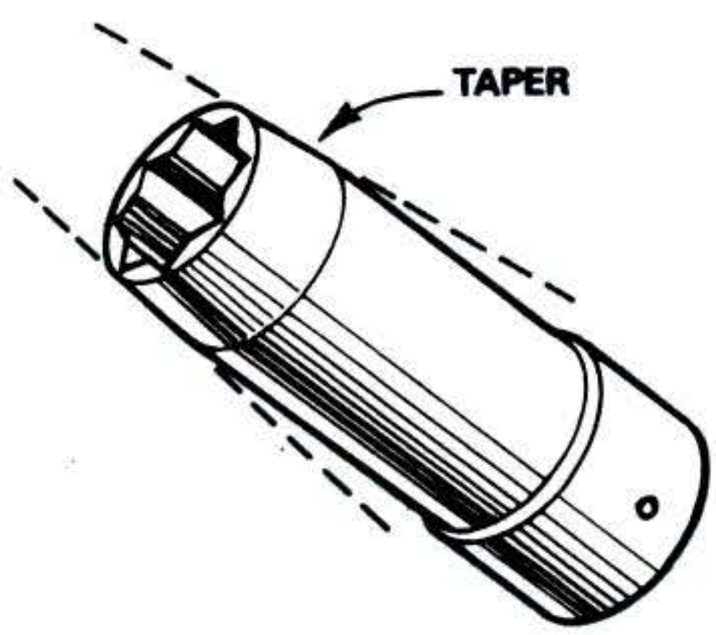
Eliminate the static

If your voltmeter is reading erratically, it may be the result of static electricity on the lens, which can occur when you wipe the lens with a clean rag. The cure: Spread a thin film of dishwashing liquid on the lens with your finger. This will remove any static charge.



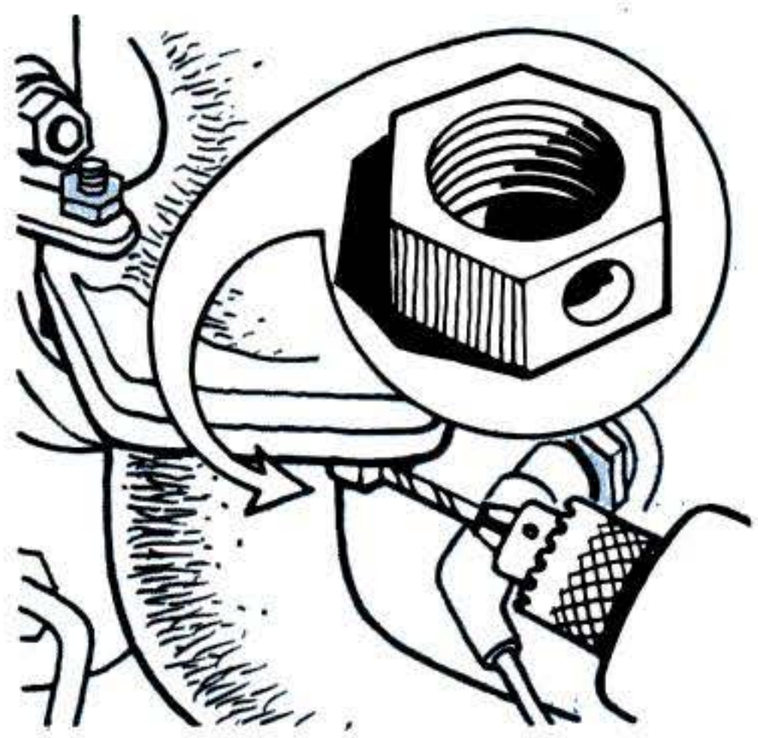
Securing floormats

Floormats sliding around? Try securing them with a strip of Velcro at each corner of the mat. If your car's carpet doesn't have sufficient nap to give the Velcro a good grip, attach the bottom half of the strip to the carpet. This system will also work well for fastening the cargo-area carpeting in station wagons, though it may be necessary to use longer strips of Velcro to hold down larger pieces of the carpet.



Straightening tabs

Bend-over tabs on exhaust manifolds or camshaft drive gears are sometimes hard to straighten with the tools you have at hand. The solution is to grind a taper onto the edge of a deep socket that's the same size as the bolt whose tabs you wish to straighten. Tap the tapered socket onto the bolt; its leading edge will slide under the tab and will force the tab up as you continue to tap.



Drill off stuck nuts

If you're struggling to loosen a large nut on your car's exhaust manifold and neither penetrating oil nor heat can loosen it, you may have to drill it off. Drill a ¼-inch hole all the way through the side of the hex nut, being careful not to damage the stud. This will relieve the tension so the nut will unscrew. For smaller nuts elsewhere on the car, reduce drill size accordingly. PS

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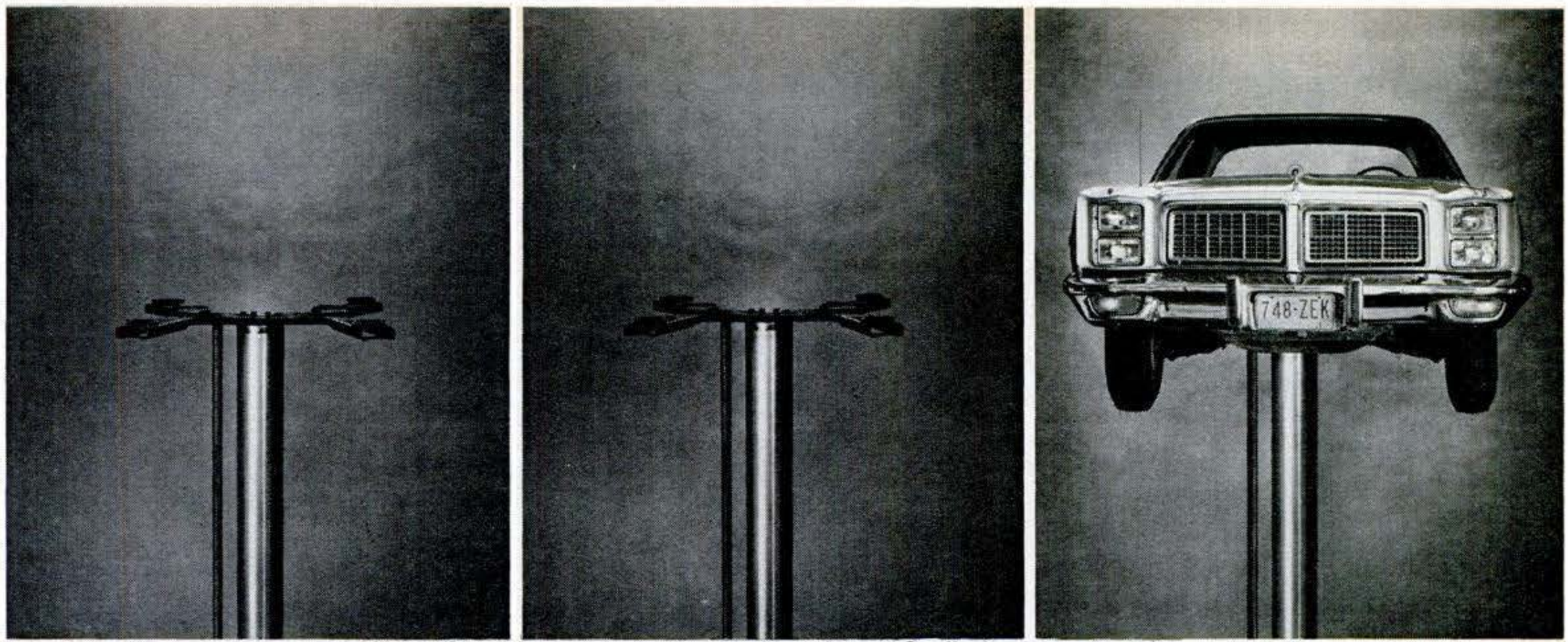

With Mobil 1 you can eliminate at least 2 oil changes a year.

Spend less time in the air.

Switching to Mobil 1 is a good way to keep your car where it belongs. On the ground.

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The oil that saves you gas.

Mobil 1 cuts friction so well it actually takes the average car up to 10 extra miles on a tankful of gas.

The oil that saves you oil.

Since Mobil 1 doesn't evaporate as rapidly as ordinary oil you should be using less oil. (Provided, of course, that your engine is in good mechanical condition.)

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So if you're up in the air about which oil to buy, come down to earth.

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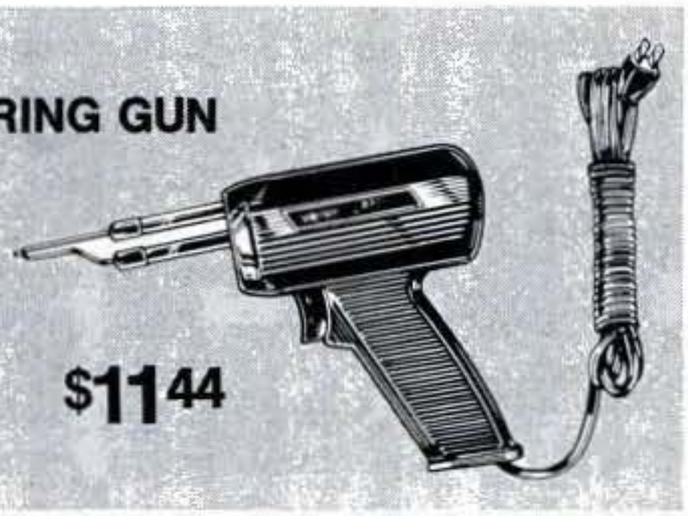

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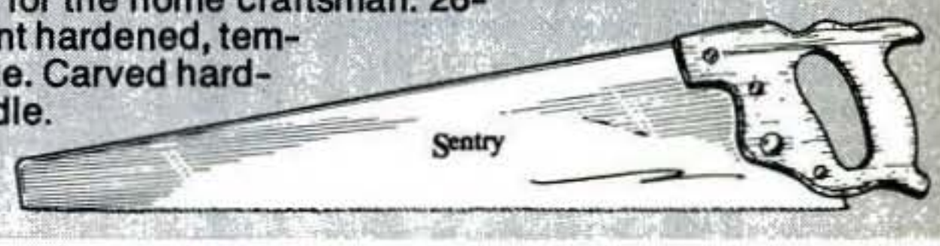

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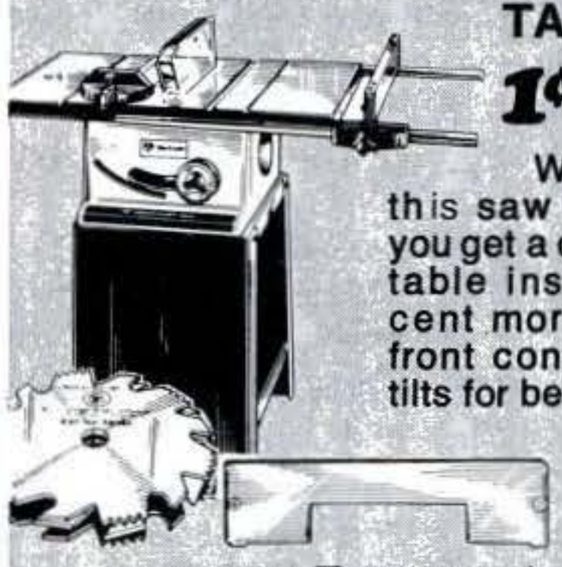

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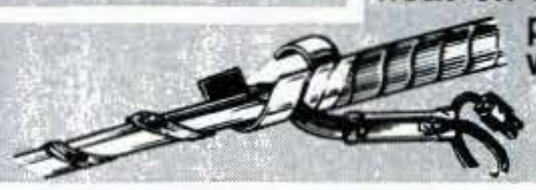

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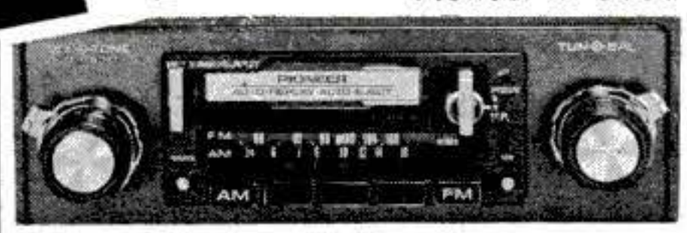

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Colder winters ahead?

[Continued from page 102]

is slowly moving in the direction of least tilt. Minimum tilt reinforces the cooling effects of the wobble cycle.

Finally, the longest climate cycle measured in the sea cores was 93,000 years. That's the period it takes the earth to swing ponderously from a near-circular orbit to its most stretched-out elliptical orbit and back again. When the earth is at the farthest point from the sun it naturally gets less solar radiation than when it's closer in. So minimum sunshine falls when the earth's orbit is most elongated. Again, this cycle reinforces the others. Today, the earth's orbit is midway between its extremes, and is moving slowly toward its most elongated shape.

From this evidence, it seems that the wobbling, tilting, erratically traveling earth is leading us down an icy road. But don't look for glaciers in your backyard—yet.

Here's Hays' prediction: "The long-term trend over the next several thousand years is toward extensive northern hemispheric glaciation." But, he added, "Even in the early stages of a cooling trend, there could be a significant impact on the length of the growing season."

Is this the final word on the future? No, it's not as neat and tidy as it seems. There are all kinds of confusing and complicating factors. For example, just a few degrees drop in the average summer temperature, if consistent year after year, will awaken the glaciers. But at the moment, it's difficult to tell just where the annual air temperature is headed.

And there's another element that could affect the 100,000-year cooling cycle—human intervention.

Some meteorologists think that pollutants vented into the atmosphere might block out some solar radiation, causing the planet to cool down. But others argue that the thicker upper-atmosphere layers may create a "greenhouse," heating up the earth.

Last July, a National Academy of Sciences panel came down firmly on the greenhouse side of the debate. If the world continues to burn coal, oil, and natural gas, and to pump huge quantities of carbon dioxide into the atmosphere, the NAS panel warned, the result could be as much as a nine-degree increase in the planet's mean air temperature. And that could spell disaster for the croplands on the planet.

So whether the earth cools down or heats up, the long-range future could be uncomfortable. But what about right now? Are we in for another bitter winter?

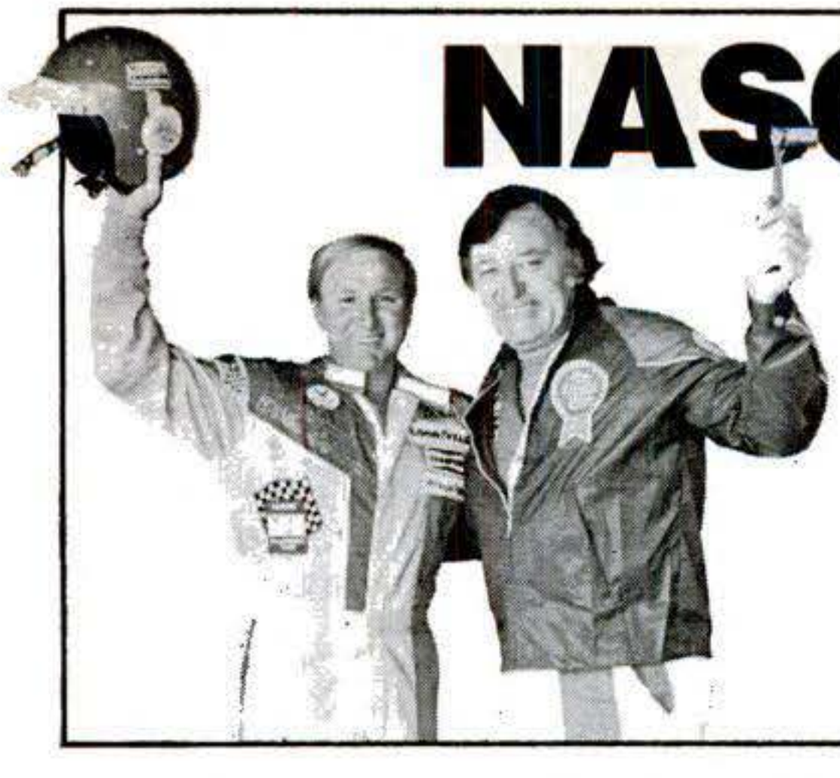
Scientists have been analyzing 1976's weather patterns, hoping to find signs that would warn of an impending severe winter. Now, some meteorologists think there may be two tipoffs: differences in the surface temperatures of the Pacific Ocean; and the kind of autumn that precedes the winter.

In summer '76, huge Pacific pools of warm and cool water helped create those atmospheric highs and lows that first steered the westerlies off course. As of last summer, Jerome Namias said he hadn't seen any signs that the same kind of contrasting surface temperatures were developing in the North Pacific.

But meteorologists are still carefully monitoring temperatures this autumn. "We're beginning to think that the fall, and particularly the month of November, is a pretty good indicator of what sort of winter we'll be in for," explained NOAA's Robert Dickson. "We said last November that based on statistical analysis of previous years and based on autumn temperatures—it was one of the coldest falls in a hundred years— the winter of 1976-77 would have below-average temperatures." (See maps.)

Dickson's group has played a key role in setting up NOAA's new Climate Diagnostic Center. This unit will monitor current climatic fluctuation on a monthly, seasonal, and yearly time scale, and will try to prepare accurate forecasts for those time intervals. "It will become more and more important for weather forecasters to predict changes six to nine months ahead," said the group's head, Dr. Donald Gilman.

With advance warning, we might prepare for a bad winter rather than struggling with it after it has already arrived. Fuel reserves could be set aside for certain vulnerable areas. Critical supplies could be stockpiled during the chilly autumn months in case subzero winter temperatures paralyze the transportation network. As Terence Blasing comments: "If we're going back to a pattern of greater climatic variability, it sure makes more sense to anticipate it than be overwhelmed by it." PS



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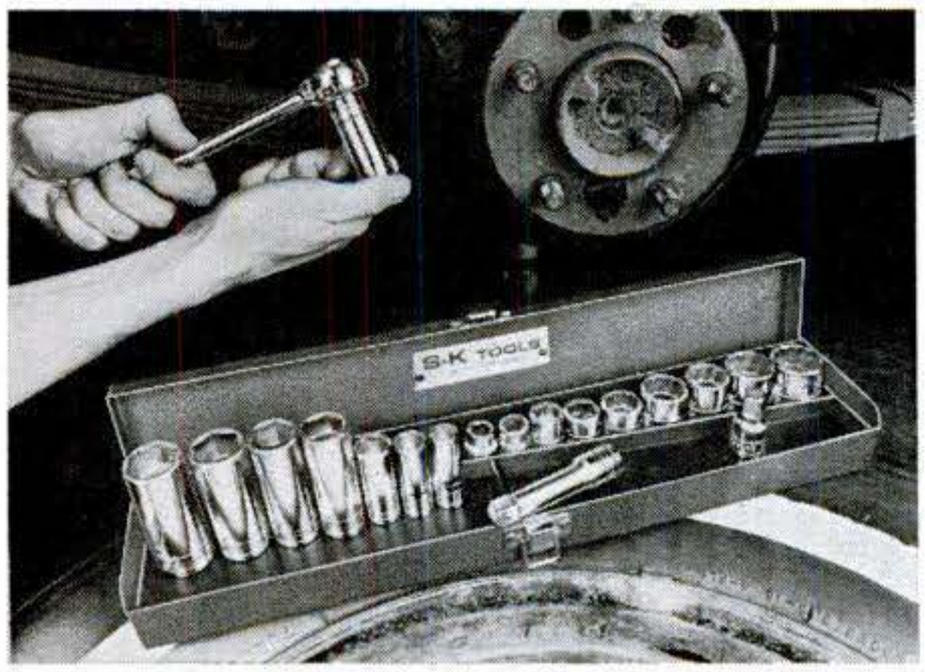

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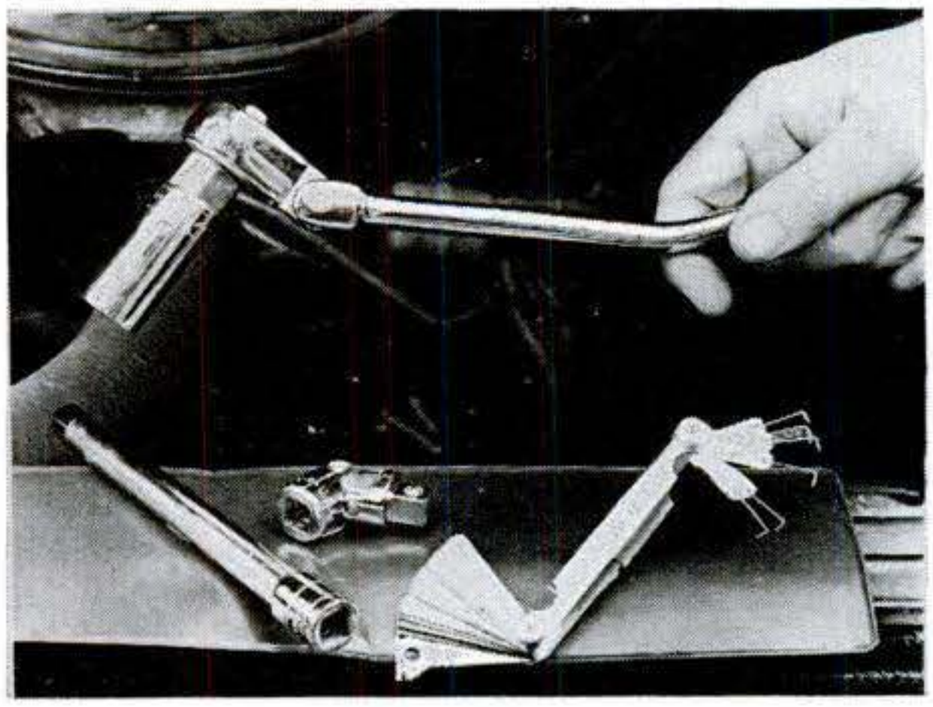

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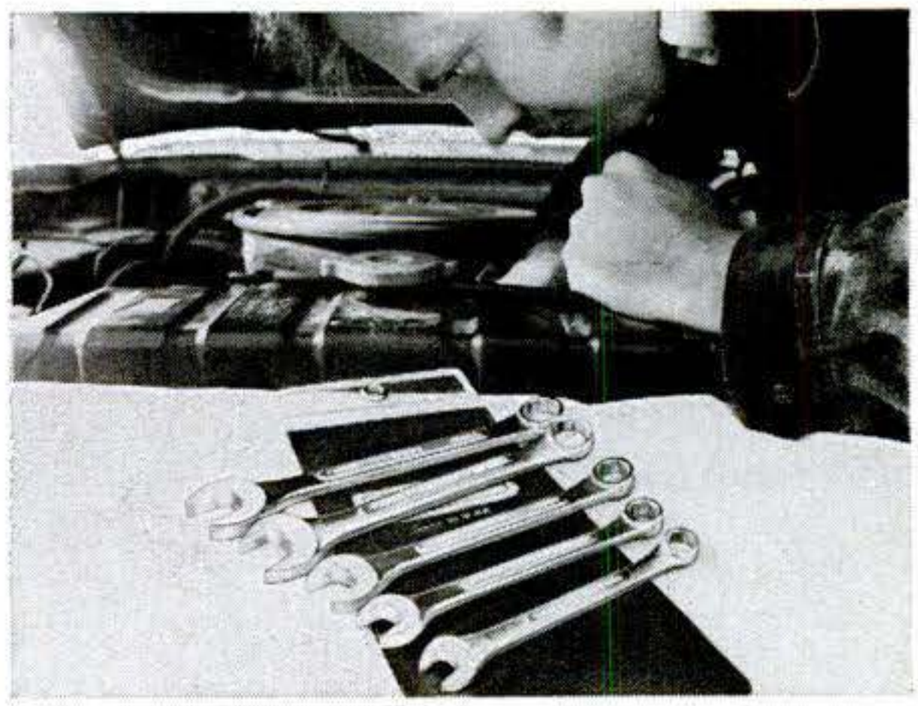

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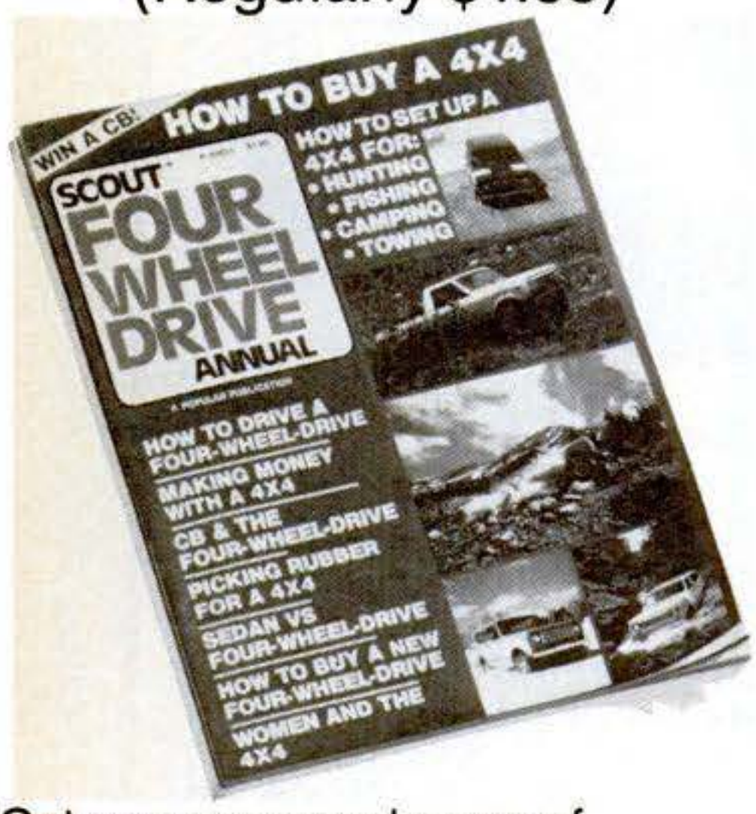

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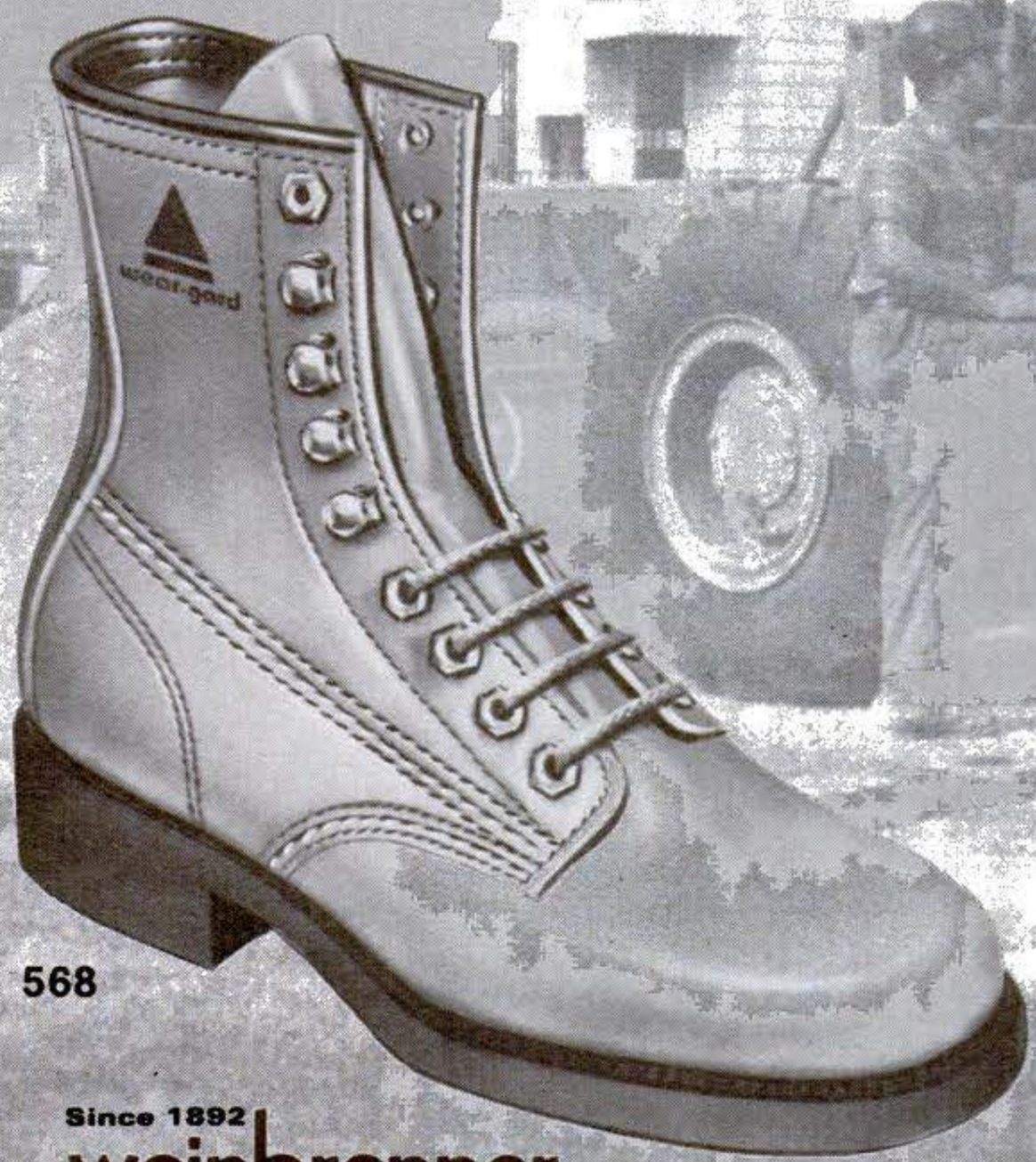

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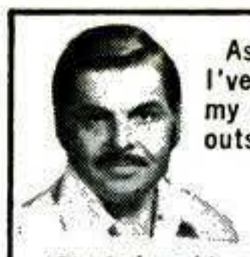

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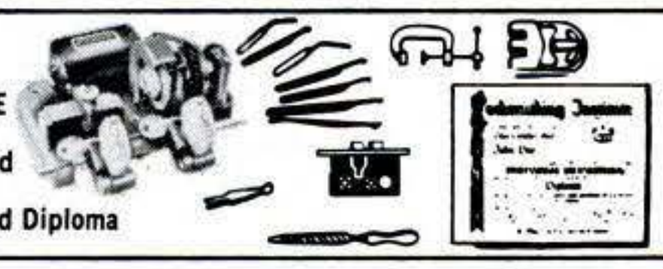

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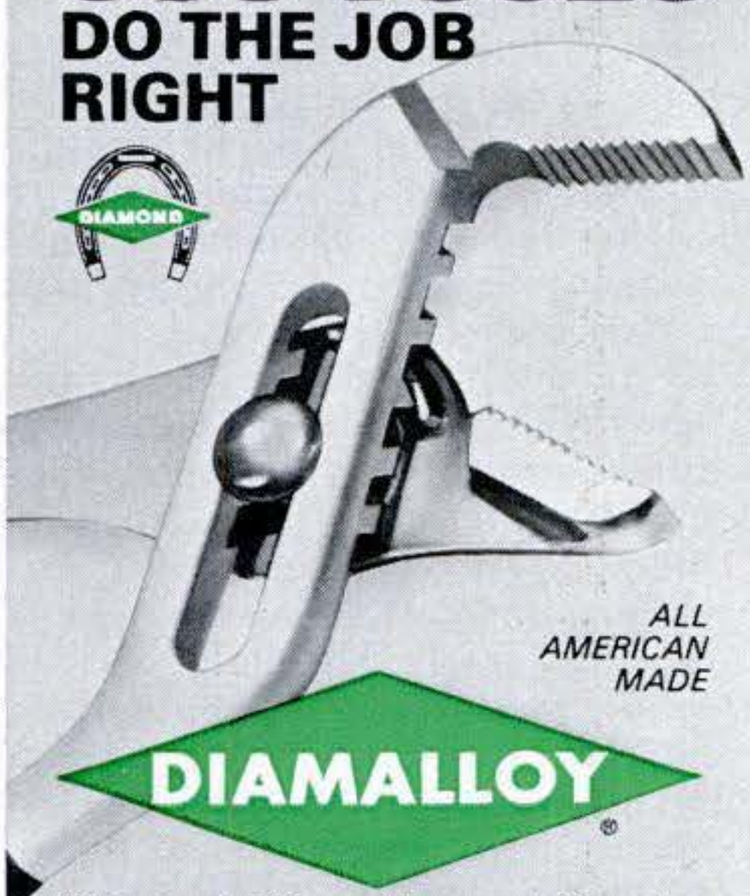

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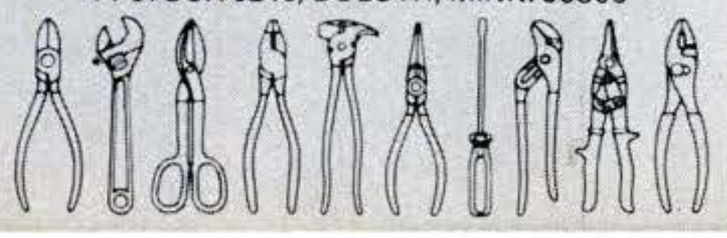

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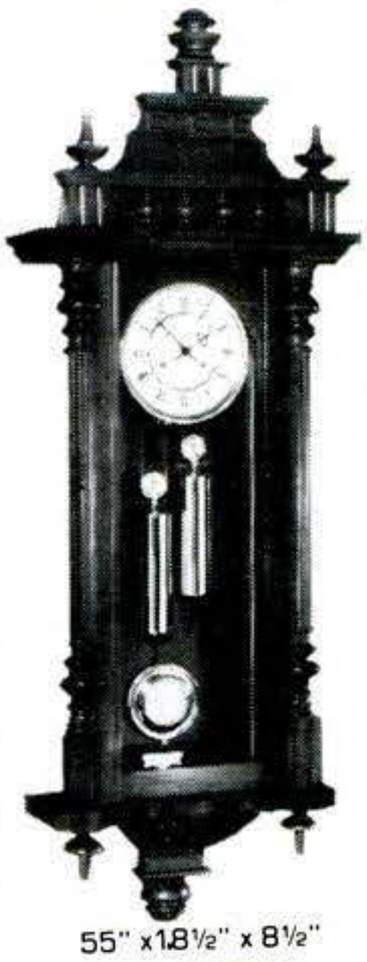

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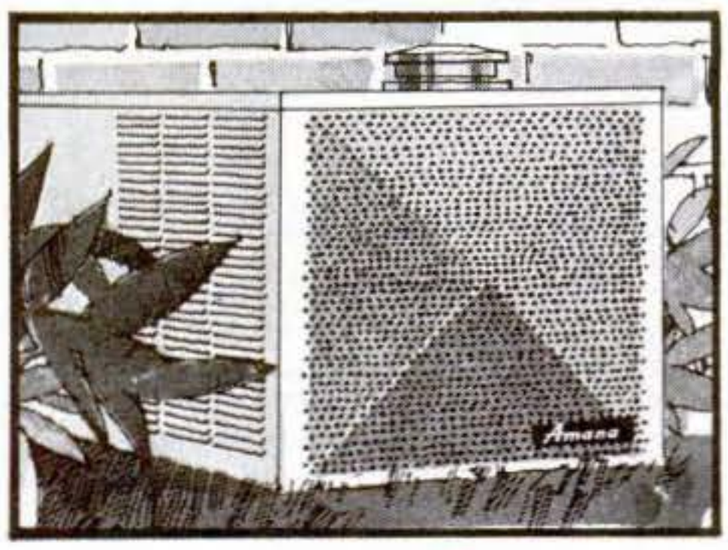

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Shirt-pocket tape recorders

[Continued from page 16]

drive system accounts for some of the vastly superior quality of this type of machine over the spindle drives. But it's also clear that the more expensive and sophisticated mechanical design of these machines is matched in most cases by more elaborate electronics. All of the capstan-drive machines have a very useful fast-forward mode; among the spindle drives I checked, only the GE has a satisfactory fast forward. Most capstan models also have audible rewind and fast-forward positions that let you quickly locate the beginning or end of a recorded segment. The Sankyo and all Olympus-type machines are considerably more sensitive than the spindle types, both close-up and at a distance, and provide more satisfactory playback amplification.

Another feature borrowed from standard-size cassettes is a knockout lug on each side that works with an interlock on the recorder. When you pry it out you can't move the machine into record mode, and therefore can't accidentally erase a recorded side. Should you want to reuse the cassette, however, you need only tape over the exposed hole.

Considering the combination of higher quality and a greatly expanded range of useful features, it's little wonder that capstan-drive recorders can do more of the jobs you want done. I found them all satisfactory for note-taking and memo-writing in noisy places, such as cars, trains, and planes.

Students should find—as I did—that they come in handy for unobtrusive recording at lectures where it isn't practical to shove a microphone under a speaker's nose. And while a remote microphone (available for nearly all units of both types) would be better for recording a sound track for a home movie. I'd rate all the Olympus-type and Sankyo machines effective at 20 feet or more from a sound source. They're also perfect for mailed-tape correspondence because a cassette recorded on one machine should give distortion-free playback on any other that takes the same size.

Dictating machines

Though some recorder makers talk proudly of high-fidelity sound (and frequency response from 200

Continued

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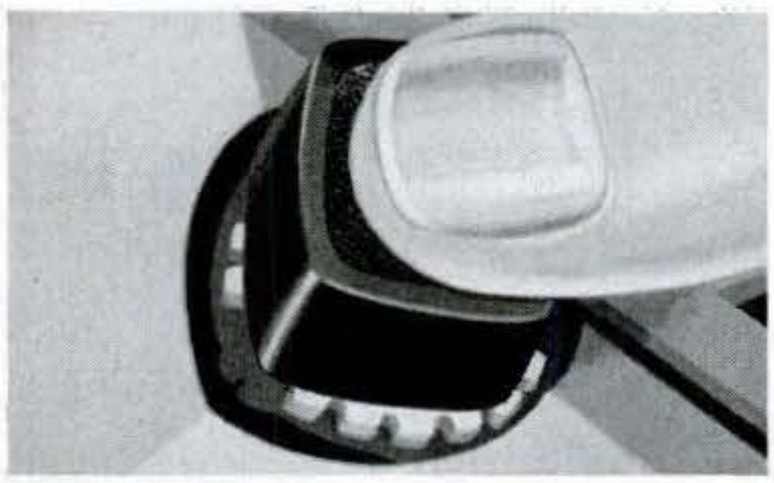

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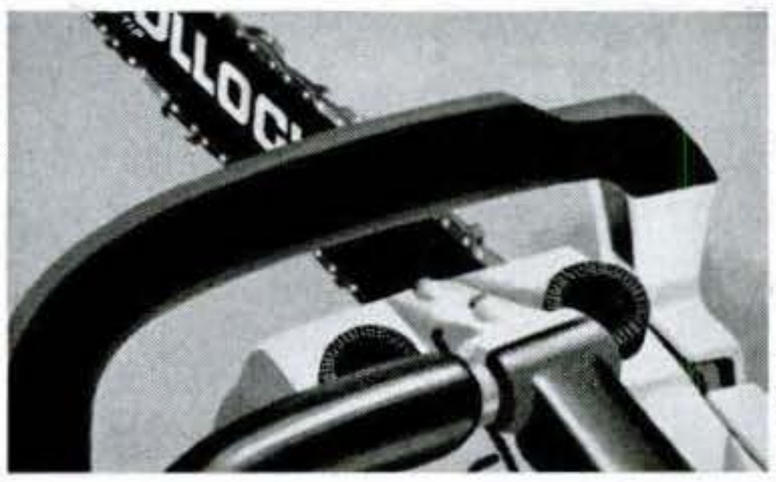

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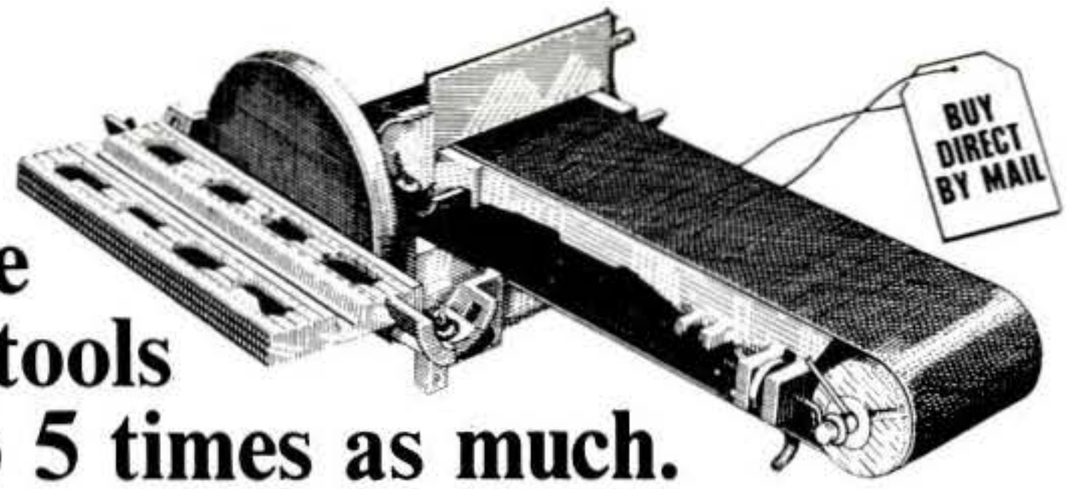

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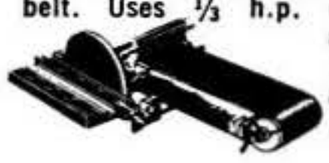

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Shirt-pocket tape recorders

[Continued]

to 7000 Hz in some models), a major segment of the industry wants no part of such refinements. I'm referring to the makers of dictating machines. These companies make a point of the distinction between recorders and their own products. They favor deliberately limited frequency and sensitivity ranges, and aim rather at day-in-day-out durability, simplified controls, and limited operating modes.

How can you choose among the many models? My own best-buy preferences are the $40 J.C. Penney among the spindle drives, and the $130 Panasonic for longer playing time, better sound, and all-round superior quality of the capstan system.

Among the features you should consider in choosing are location of controls, positive action, and ease of use. I also liked the audible end-of-tape warning, available on many models; it keeps you from talking to a machine that isn't listening.

All the Olympus-type recorders and certain others have a handy light-emitting diode to show when you're in recording mode and battery condition is okay.

I ran into a little trouble operating some controls. On several of the simpler spindle-drive models I accidentally erased a couple of tapes by switching to record when I thought I was in play. This isn't a problem on most capstan models because two definite movements are needed to switch into record mode.

Once you get used to vest-pocket recorders you'll find them handy for jotting down thoughts while they're fresh in your mind. But with the wide range of attachments now coming on the market, they could also be poised for a big move in go-anywhere entertainment. PS

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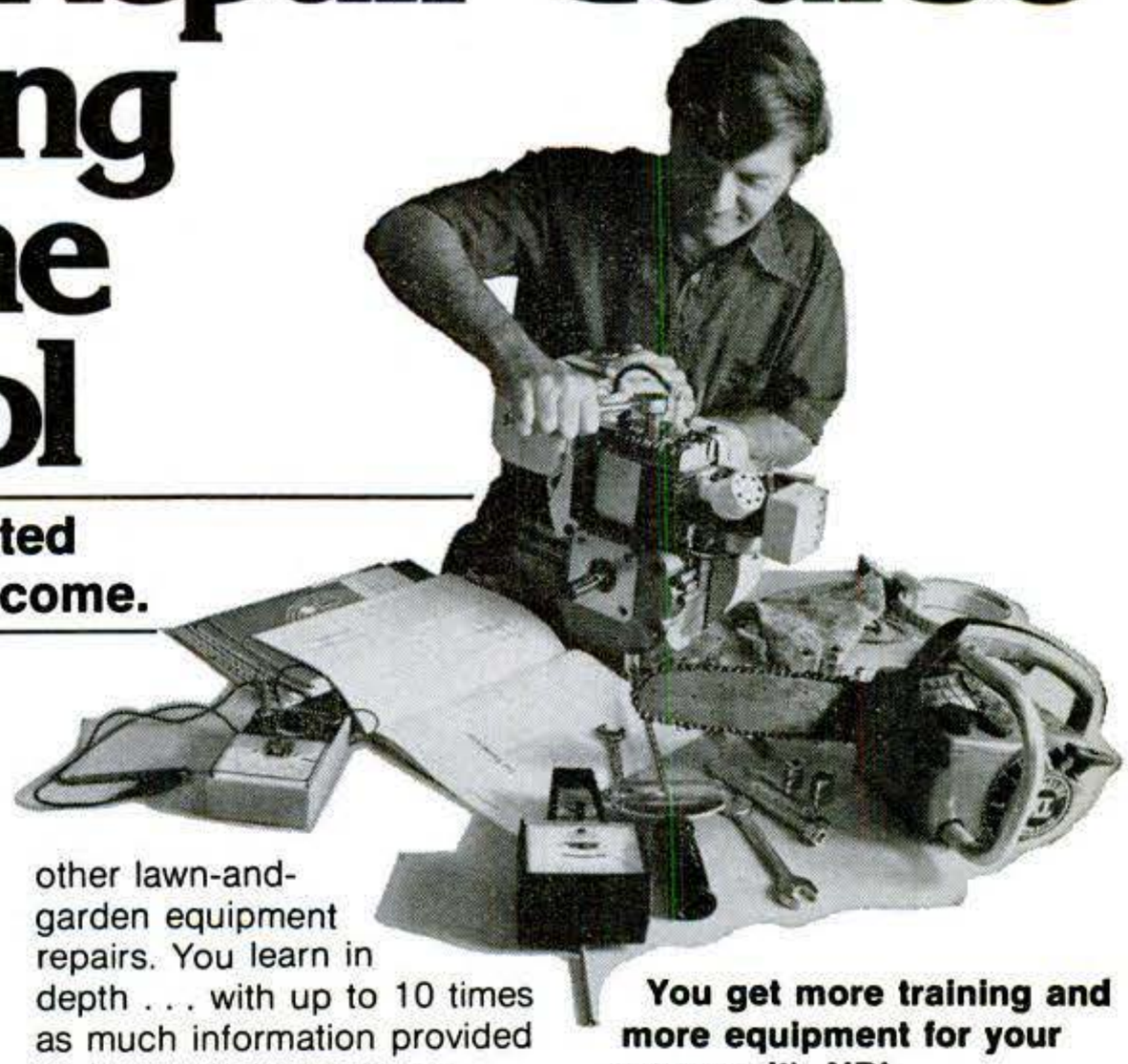

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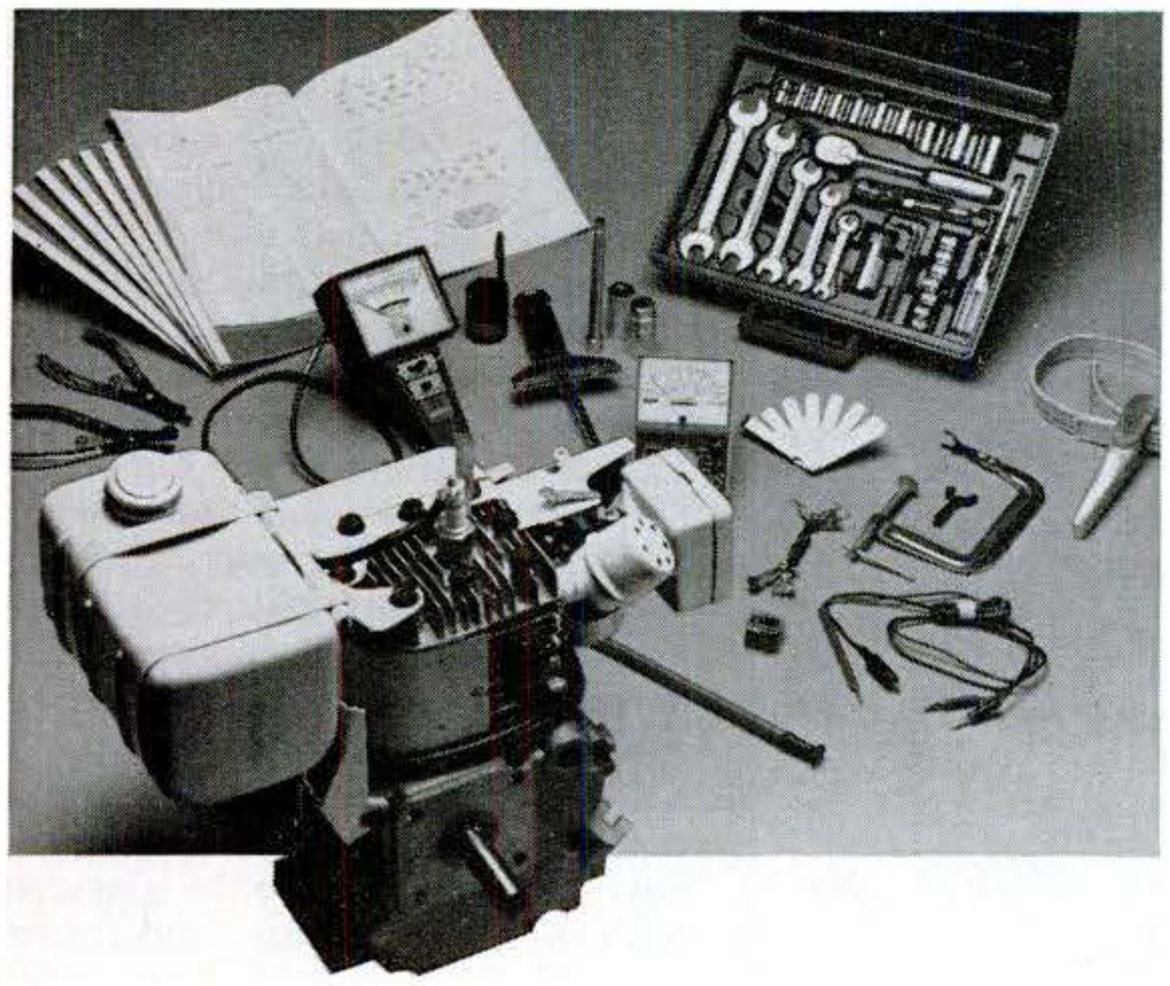

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37-year puzzle

[Continued from page 28]

to measure the magazine illustration, a questionable method since there was no guarantee the drawing had been made to scale. Actually it was, as close as its size permitted.

Most scalers used repeated tries with assumed distances to find the speed within one or two mph by ruler and compass. Each successive guess brought the intersections of arcs from B, C, and D closer.

H. E. Fottrell of Chattanooga found a more direct mechanical method that avoided both assumptions and repeated calculations. To two nails driven into plywood 15 inches apart, he fastened the ends of two pieces of flexible wire having lengths one-sixth and one-third greater than 15 inches. Allowing a carpenter's square to pivot against one nail, he stretched the two wires until they touched the square at equal distances from the pivot. Since this distance, which he found to be 7.75 inches, represented 10 miles, he needed only to divide one-tenth of it into twice the 15-inch length to reach a respectably accurate answer of 38.7 mph.

Trig-happy solutions

Other than scaling, the most obvious solution is by way of trigonometry. This is attested to by the fact that two-thirds of all successful solvers started with something called the law of cosines. Quite a few of these were people currently working with math, as indicated by accompanying notes, engineers' professional stationery, and—surprisingly often—use of graph paper.

About 15 percent of those who mastered the problem did so with the help of analytic geometry. Another 15 percent used plane geometry, adding construction lines to form new right triangles either inside or outside the original figure. From these initial steps, application of that most familiar of theorems (the square of the hypotenuse . . .) and some elementary algebra brought them to a quadratic equation, whose roots gave the answers.

A few rare spirits offered unique variations on these basic approaches. One of the dozen identifiably female contributors used an unusual blend of trig functions and laws. Rallying not only sines and cosines but tangents and inverse tangents as well, Stephanie Adair Vickery, La Porte, Tex., found the car's speed without needing to solve a quadratic equation.

Continued

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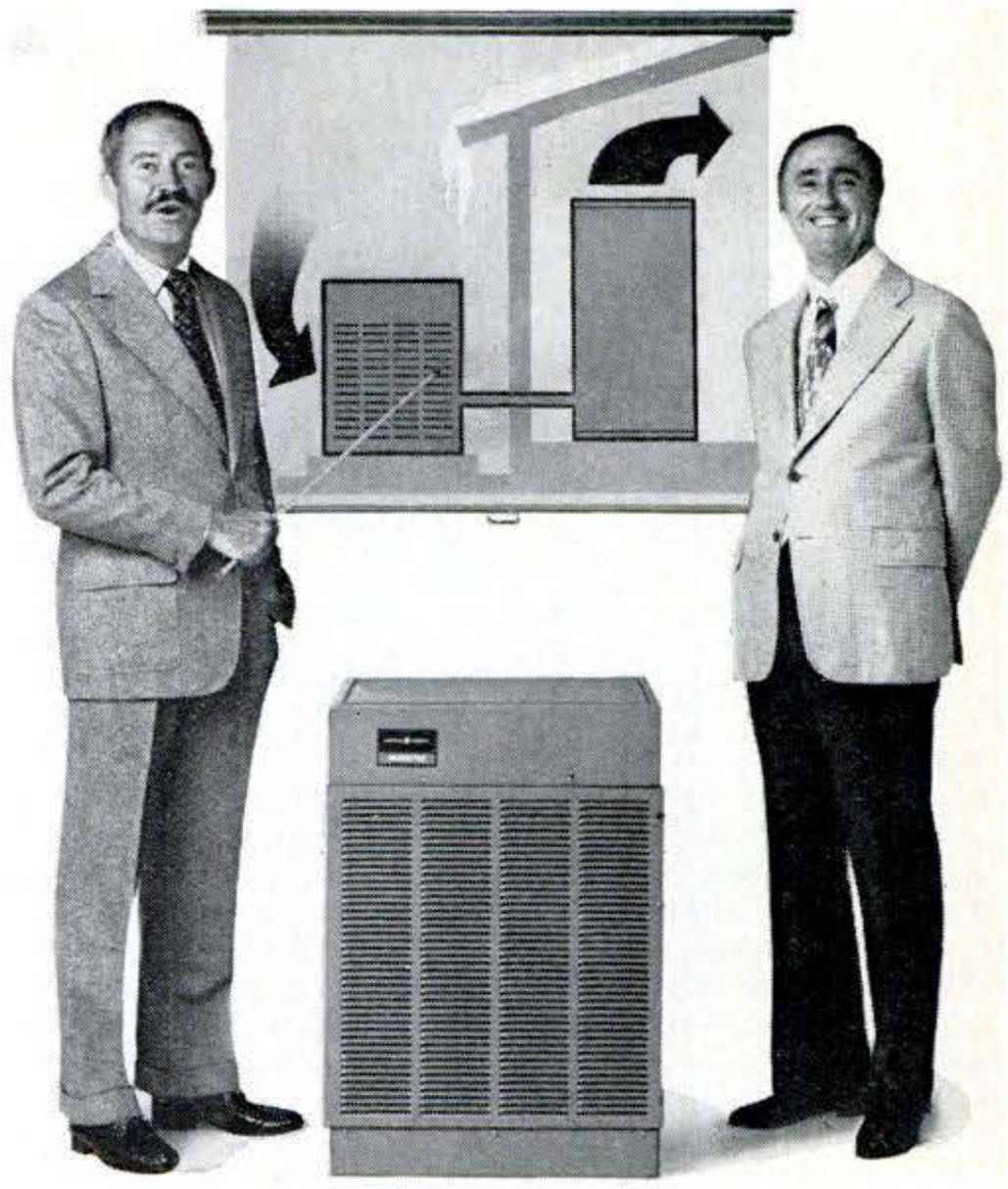
Rowan and Martin explain how the GE Weathertron® Heat Pump can cut your bill for ordinary electric heat 30-60%.*

1. Dan: The General Electric Weathertron heats your home in the winter, cools it in the summer.
Dick: Like a furnace and an air conditioner in one.



2. Dan: Even on cold days, there's heat in the outside air. The Weathertron extracts this heat and pumps it into the house. Very often, that's all it takes to heat a house.
Dick: And no gas or oil shortage to worry about.

3. Dan: Then in the summer, it works in reverse—it's an air conditioner—pumps heat from inside the house to the outside.
Dick: Keeps you comfortable all year round.

4. Dan: *Saves you 30-60% on your heating bill—compared to ordinary electric heating, depending on where you live.
Dick: Makes perfect sense to me.

For more information, write to General Electric; Appliance Park, Bldg. 6, Room 220, Louisville, Ky. 40225.

GENERAL ELECTRIC

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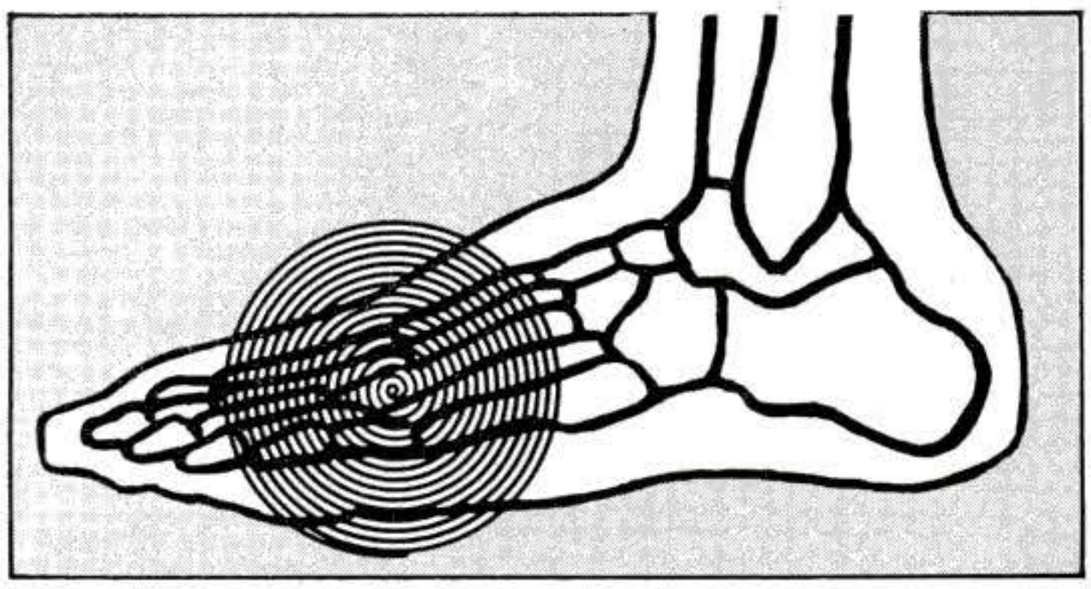
My Feet Were Killing Me...Until I Discovered the Miracle of Hamburg!



It was the European trip I had always dreamed about. I had the time and money to go where I wanted—see what I wanted. But I soon learned that money and time don't mean much when your feet hurt too much to walk. After a few days of sightseeing my feet were killing me.

Oh, I tried to keep going. In Paris I limped through Notre Dame and along the Champs-Elysées. And I went up in the Eiffel Tower although I can't honestly say I remember the view. My feet were so tired and sore my whole body ached. While everybody else was having a great time, I was in my hotel room. I didn't even feel like sitting in a sidewalk cafe.

The whole trip was like that until I got to Hamburg, Germany. There, by accident, I happened to hear about an *exciting breakthrough for anyone who suffers from sore, aching feet and legs.*

This wonderful invention was a custom-made foot support called Flexible Featherspring. When I got a pair and slipped them into my shoes *my pain disappeared almost instantly.* The flexible shock absorbing support they gave my feet was like cradling them on a cushion of air. I could walk, stand, even run. The relief was truly a miracle.

And just one pair was all I needed. I learned that women also can wear them —even with sandals and open backed shoes. They're completely invisible.

Imagine how dumbfounded I was to discover that these miraculous devices were sold only in Europe. Right then I determined that I would share the miracle I discovered in Hamburg with my own countrymen.

Today thousands of Americans of all ages—many with foot problems *far more severe* than mine—have experienced this blessed relief for themselves.

Here's why Featherspring work for them and *why they can work for you.* These supports are like nothing you've ever seen before. They are custom fitted and made for *your feet alone!* Unlike conventional devices, they actually imitate the youthful elastic support that Nature originally intended your feet to have.

Whatever your problem—corns, calluses, pain in the balls of your feet, burning nerve ends, painful ankles, old injuries, backaches or just generally sore, aching feet. Flexible Featherspring will bring you guaranteed relief with every step you take.

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37-year puzzle

[*Continued*]

Forming the smallest minority were the four players who began with equations for the two ellipses that can be drawn through B and through D with A and C as foci. One of these elliptical solutions came all the way from Gordon D. Bredvik at Ramstein Air Base in Germany. But his was by no means the only long-distance offering. Rien Blomsma, in Rotterdam, uniquely blended construction of a rectangle with Hero's formula for the area of a triangle to find his way. Reuven Amir used a distinctive mix of sines, cosines, and tangents in a correct solution sent from Ramat Hasharon, Israel. Also using cosines were Nestor Perez (Caracas) and Rune Fredrikson (Hagerston, Sweden). Readers in Windhoek, South West Africa, and Salamanca, Spain, came croppers with 37.314 miles per hour and 27.6923 *millas per horas* respectively.

How to go wrong

Like most wrongos, these ignored the right angle stipulated between the 10-mile legs of the two alternate routes. Doing so leads to an infinity of solutions, as many noted. A fellow in Newburgh, N.Y., went to considerable trouble to program a computer to print out in two-inch letters (the T being made up of T's, and so on) the dictum that THERE IS NO ANSWER.

One thread running through much of the correspondence accompanying the solutions was that of pleasure. Pleasure of digging through old math books. Pleasure of using almost forgotten formulas and polishing up rusty old skills. And, most notably, pleasure at finding another and most stimulating exercise for their electronic calculators. ("Bless that little black box!" said a New Hampshirite.)

Not that the joy was unanimous. On stationery imprinted "A note from Pearlie," the almost-but-not-quite answer of 36⅔ mph was introduced by this plain challenge: "You men make me sick with your fancy calculators and stupid math."

There was also something a little sharp about one Canadian contribution. Signed only with initials, it was datelined Toronto, September 8, 1939. Its author expressed hope that the accompanying solution would arrive in time to be helpful. "I understand," he said, "that the United States postal service is quite slow, especially in these war times." PS

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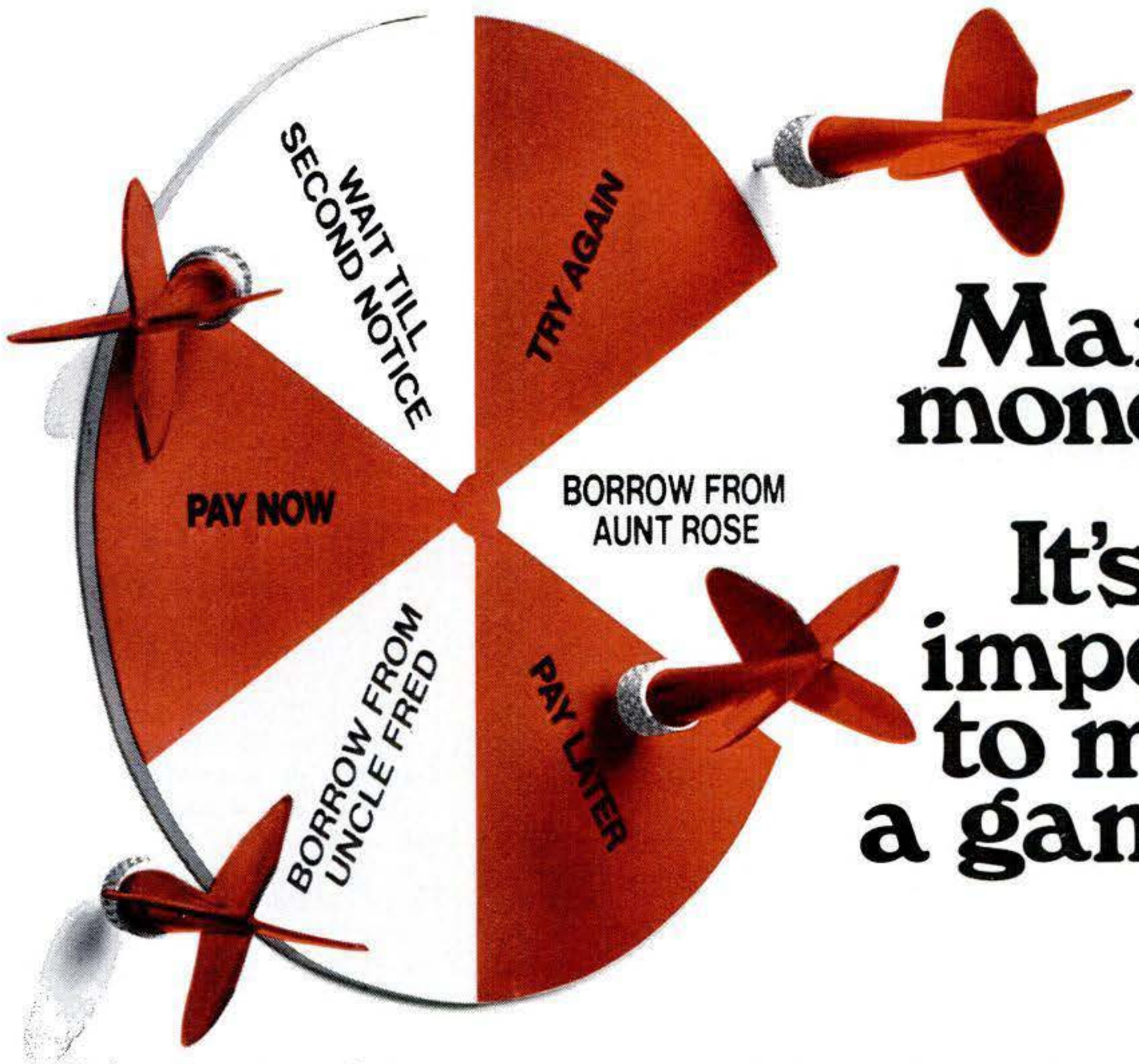

Managing money.

It's too important to make a game of it.

With some people, it's hit or miss.

Even for the vast majority of us who take our financial obligations seriously, balancing a budget isn't easy. Just when you think you've found the answer, inflation takes another bite out of your paycheck. And everything starts costing more. Putting the kids through school. Food. Clothes. A better home. Or even new appliances. Sometimes it makes you wonder if you ever can get ahead. No matter how hard you try.

Take an opportunity, not a chance.

Fortunately, there is someone you can turn to for help. Your Credit Union. Our business is helping people get more out of their money. We can help you save. Help you borrow. And, if you like, we can even show you how to avoid future money problems by suggesting practical strategies that really work.

We play it straight.

Too many organizations try to use personal financial counseling as a way to sell other services. A consolidation loan. A fee. A gimmicky savings account. Your credit union doesn't operate that way. Our financial counseling is free to each member. No strings attached.

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For information, please write your state's credit union league or CUNA, P O Box 431, Madison, WI, 53701.

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[Continued from page 137]

top end of a two-way servo valve's piston is passed over by the pressurized recess and the port leading to the piston's bottom end is under the drain recess, the piston moves downward, opening the valve. The other way around, it closes.

Three servo valve pistons are single-acting—pressurized to open, self-closing under fluid pressure. The other four are double-acting. Depending on which recess passes above a valve's ceramic disk ports as the regeneration control gear rotates, the valve opens or closes. (The table shows a full double-cycle program.) Together, the ceramic disk and regeneration control gear produce 24 hydraulic signals that control all of the softener's regeneration actions.

One side of the ceramic disk serves tank 1 ports; the other side serves tank 2 ports. A 180-degree revolution of the gear thus goes through the entire regeneration cycle for one tank. A projection into the gear's drain recess closes the master control valve's port twice each revolution. When the valve is closed, water to the regeneration turbine is cut off, stopping it and halting the gear in its "regeneration-accomplished" position. It stays there until it's time for another regeneration.

When to start another cycle?

The unit senses this in the function of the top gear, called the water-meter disk, which is turned about one revolution every 1000 gallons by the water-use turbine. The water-meter disk has from one to six wide spots around its gear teeth. The teeth merely idle as it turns, until a wide spot reaches out to engage a small idler gear that spans between it and the regeneration control gear. A matching wide spot in the lower regeneration control gear in its stopped position stands enmeshed with the idler. As the upper wide spot meshes, the idler rotates, turning the regeneration control gear in unison with it and exposing a control-valve port. This starts the regeneration turbine going on its own cycle.

Another bit of hydraulic heroics is in a balance system. The softener must be able to work at water pressures ranging from 15 to 125 psi, yet the regeneration control gear works best under a constant load. It's done with a coil-spring preload from above. The underside of an O-ring-sealed balance piston works at ambient pressure, its topside at water pressure. For balance, piston area equals pressurized recess area. The piston pushes down on the spring to equalize pressures.

Ohio inventors William C. Prior and James W. Kewley created the softener—and its incredible turbine-powered programming. In dream-come-true fashion, the inventors have become manufacturers and marketers of their product. They furnish it in four models to handle water hardness to 115 gpg. Retail prices are claimed to be competitive with other softener brands.

I have no idea how long the unit would keep working; however, the maker claims it has passed punishing accelerated 10-year-life tests, and claim reliability and efficiency never before achieved.

For more information, contact Kinetico, Inc., Newbury, Ohio 44065. PS

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Wood stains

[Continued from page 135]

paste-wood fillers, varnishes, and lacquers.

Specialty stains

In addition to the two big classes of stains mentioned so far, there are also a number of specialty products. Here's a quick listing:

- *Varnish stains.* These are, at their best, colored dyes dissolved in varnish. The idea is to stain and varnish stains in to darken and seal very well. The problem is brushmarks: Slight variations in the thickness of the varnish film create large variations in the shade of the stain. Brushmarks show as a sort of phantom grain. The best use for varnish stains is to darken and seal inconspicuous parts of your work, such as insides of drawers or backs of cabinets.

Another application for varnish stains is toning and shading. You can apply the stuff with a cheap hobby air brush to blend in light pieces of wood on furniture glued up from stock that lacks uniformity of color. I also used it to put a beautiful shaded finish on a guitar.

- *Spray stains.* In aerosol cans, these may be varnish stains or stains built around a lacquer base; they are most useful for blending.
- *Blending stains.* These are powders used for touching up and repairing over existing finishes. You apply them by rubbing them in with a rag dampened with a padding lacquer. They can also be used to finish bare wood, again by rubbing, but this is a technique that requires more skill than any other staining method.
- *Bleaches.* These are not actually stains, but they are used for the same purpose; changing the color of wood. The most potent are the two-part bleaches made especially for wood, which are usually based on hydrogen peroxide and oxalic acid.
- *Chemical stains.* Certain chemicals when applied to wood will change its color. For example, a dilute solution of potassium permanganate does a good job of ageing pine. The stuff is purple, but when brushed on, it reacts with the wood to form a nice amber.

Lye and washing soda will both turn wood a light brown. And steel wool dissolved overnight in vinegar will turn new pine a beautiful weathered driftwood gray. You handle all these chemical stains like water stains: An ounce of soda, lye, or potassium permanganate in a quart of water produces a good working solution. Neutralize the lye with a vinegar soak after the lye solution dries.

When to use stains

Most amateurs break out the stain when they want to make one kind of wood look like another. This is okay as long as you work within reason. Remember, staining changes only the color of the wood, not its grain pattern and pore structure. So if you want to fake a piece of walnut, at least start with a wood with similar grain and texture.

Birch plywood, for example, will stain to look quite a bit like a number of other hardwoods. Fir plywood will not. It has a wild flamelike grain that will give it away no matter what color you stain it.

Another reason for staining is to make new wood look older. Turning a piece of fresh white pine into an instant antique is easy with stains. It will give good results far more often than staining to duplicate another species.

The most common reason for staining the fine hardwoods is to give them the color we have grown to expect from them. Most of the hardwoods I see today lack character. Maybe it's because they are force-dried and rushed through the lumbermaking process before they have a chance to age. But stains can perk them all up. PS

WHERE TO GET THEM

Most paint stores don't stock water and NGR stains, although they may be able to order them for you. Mail-order sources are your best source of supply. But since you can't get instant service by mail, it makes sense to order a minimum selection of stains so you'll have them around when you need them. For less than $5 you can get a selection of water stains (red mahogany, brown mahogany, black, yellow maple, for example) that will allow you to mix up almost any wood tone you'll ever need. Sources?

H. Behlen & Bro., Box 698, Amsterdam NY 12010. Behlen is the most complete source of finishing materials. They even provide a custom color-matching service. But they really aim at industrial customers, and their minimum order is $25.

Albert Constantine and Sons, 2050 Eastchester Rd., Bronx NY 10461. A good source for water stains (the only one I know that sells the one-ounce packets that make a quart of stain). Also NGR stains, blending stains, and bleaches.

Craftsman Wood Service Co., 2727 South Mary St., Chicago IL 60608.

Gaston Wood Finishes Inc., Box 1246, Bloomington IN 47401. Bleach, NGR, and other stains.

Minnesota Woodworkers Supply Co., Industrial Blvd., Rogers MN 55374. All types of stains (water, oil, and alcohol stains sold in quarter-pound containers only).

Woodcraft Supply Corp., 313 Montvale Ave., Woburn MA 01801. Water and alcohol stains, and other supplies. Stains in half-pound cans only.

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A quiet revolution has been taking place in the electronic watch industry during the last few years. Push-button LED's are being replaced with continuous-display LCD watches; 4-digit displays are being replaced by 6-digit readouts. This year there will be many such LCD watches available.

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- *Never again forgetting to make that all-important phone call.*
- *Never having to worry about forgetting to take important medication on time.*
- *Never worrying about waking up from that catnap, or at a hotel if your wake-up call isn't on time.*
- *Always being aware of when you should be coming or going or doing all that your hectic schedule demands — without devoting your valuable time to trying to remember it all.*

7:55AM

SET TO RING AT 7:55 A.M.

THE ALARM

The MICRO-ALARM has a 24 hour Alarm System, allowing you to set your watch to signal at any minute of the day or night (1,440 settings per day are possible). Once set, you need not be concerned about your next appointment or train, plane or phone call. The MICRO-ALARM will remember for you and remind you when you need to be reminded.

SNOOZE/REMIND CONTROL

For your convenience the MICRO-ALARM will give one short beep prior to its full alarm cycle, allowing you to turn it off without disturbing others. If not deactivated after the first short beep, the alarm will then beep for 15 continuous seconds. Push the deactivate button twice and the alarm is off. However, should you want a further reminder, then push the deactivate button only once and the alarm will go through its cycle again in exactly 5 minutes, allowing you to continue your current activity whether it be a snooze or phone call without fear of forgetting your next commitment.

12:34 AND 56 SECONDS

12:34 56

6-DIGIT LCD DISPLAY

The MICRO-ALARM has a 6-digit readout showing hours, minutes and seconds at a glance. Since the readout is by Liquid Crystal Display (LCD) and not by Light Emitting Diode (LED), no button has to be pushed; the time is continuously displayed! A built in night-light functions at the push of a button for reading in darkness.

AUGUST 15th FRIDAY

8:15 FR

CALENDAR DISPLAY

Just one push of the control button converts the display into a 3-function calendar; displaying the month, date of the month, and day of the week. The remarkable memory built into the module knows each month and the number of days in that month and resets automatically on the first day of the new month.

QUARTZ ACCURACY

The MICRO-ALARM is extraordinarily accurate. Its module is manufactured by Hughes Aircraft Company, one of the world's foremost manufacturers of microelectronics, and is guaranteed accurate to within 3 minutes a year (averaging less than 15 seconds per month). You can depend on the accuracy year after year. There are no moving parts, so there is nothing to wear out or even require servicing. The result of this accuracy is that you can set your watch to the second.

THINK ABOUT IT!

Even if you have no consistant need for a watch with a built-in electronic alarm, the MICRO-ALARM is a valuable investment for its watch features alone:

1. It is the most up-to-date fully-functioning electronic watch available today.
2. It is accurate to +/- 15 seconds per month, and never has to be wound — put it on, and the time and date are correct even if it has been in a drawer for a month!
3. Its elegant styling will compliment any attire — and elicit compliments from your associates and friends.
4. At this price you can not find a better buy.
5. One day you will have a critical need to be reminded of a vital appointment — and then, having used the alarm function once, you will never again return to any other reminder system.
6. Why buy an ordinary watch when you can own a MICRO-ALARM?

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Each MICRO-ALARM comes with a 1 year limited warranty. You may order in your choice of gold-tone or silvertone case. Each for only $69.95 plus $1.99 for shipping and handling. Each MICRO-ALARM comes with a matching, elegant, thin mesh bracelet, more handsome and much more practical than those "pull over-snap" type bracelets. This band adjusts comfortably and easily, eliminating cumbersome link adjustments.

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Wear the MICRO-ALARM for 15 days to assure yourself that this is no ordinary watch. If at the end of that time you are dissatisfied for any reason you may return it for a prompt refund, no questions asked.

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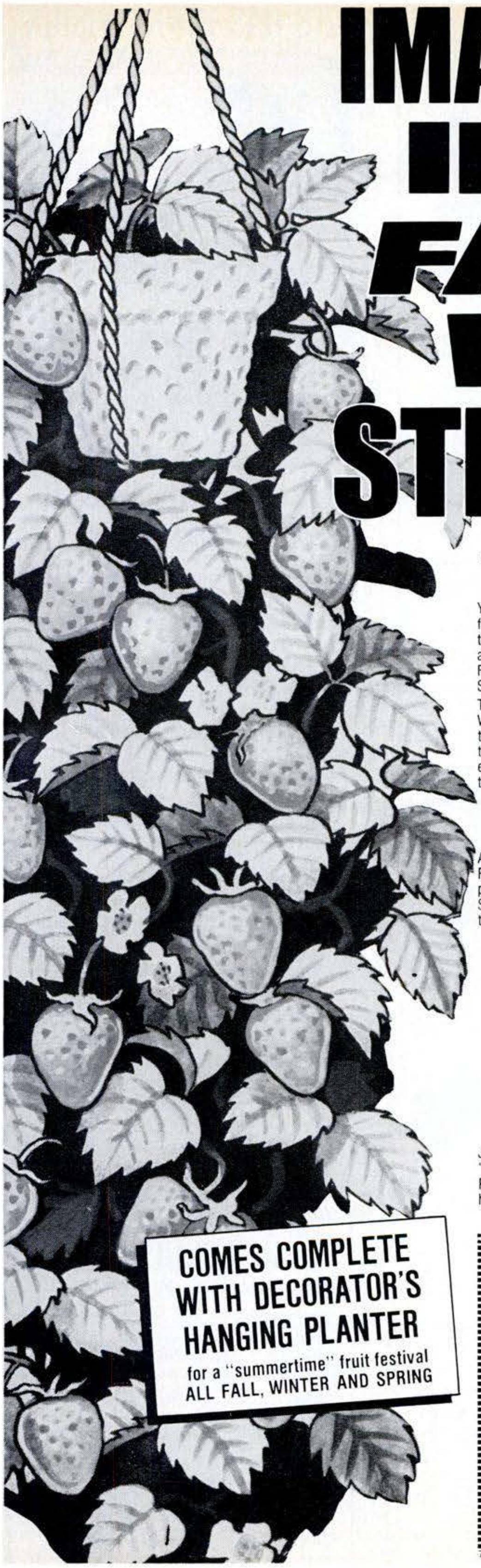

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– in just 60 days!

Yes, you simply take these winter wonder-fruits developed by the U.S. Dept. of Agriculture . . . hang them inside your home . . . and pick masses of luscious red berries ALL FALL, ALL WINTER — RIGHT THROUGH SPRING!

Think of it! An entire hanging garden of "FALL, WINTER AND SPRING" indoor strawberries that grow into a wondrous indoor orchard just teeming with basket-after-basket of the sweetest, juiciest berries you've ever sunk your tooth into.

HUGE "RESTAURANT" TYPE BERRIES JUST AS BIG, JUST AS TASTY AS THE BIGGEST OUTDOOR STRAWBERRIES!

And not just ordinary strawberries, but giant RECORD-BOOK fruits that look like small peaches. Yes, yours ALL FALL, WINTER and SPRING — a summertime feast of berries by the basketful that are:

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- SO HUGE and meaty, just one sliced-up berry tops a whole bowlful of cereal.
- SO PROLIFIC that for every giant berry you pick when it first fruits, you'll pick 2, 3 even 4 times as many as the months go by!

THINK OF IT — FROM THIS ONE SINGLE PLANT YOU GET A WHOLE FALL, WINTER AND SPRING "STRAWBERRY FACTORY"

Just imagine the taste thrills galore as you "spoil" yourself and your family with FRESH-PICKED STRAWBERRIES from your own indoor hanging garden ALL FALL, ALL WINTER, ALL SPRING, **smack up to summer starting just weeks from now!**

FOR BERRIES BY THE BASKETFUL ALL FALL, WINTER, AND SPRING — ACT NOW!

Now, the price of these wondrous INDOOR-FRUITING STRAWBERRIES is not the **$3.00** or $4.00 per plant you might expect . . . **just a** mere $2.98 for the entire 3-Plant **Hanging** Garden, PLANTER INCLUDED. And **remember** — the plants we send you are live, **fruiting,** nursery grown stock . . . all set to **grow and** reward you with berries by the **basketful** . . . berries almost the size of SMALL **PEACHES** . . . starting in just 60 days!

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GUARANTEE

For strawberries by the **basketful** starting in just 60 days simply **follow** easy growing instructions — and get set for a non-stop "**Berry** Festival" ALL FALL, ALL WINTER, ALL SPRING! Yes, basket after **basket** of giant RECORD-BOOK **fruits** — so big they look like **small** peaches — or money refunded **in** full, (except postage and **handling,** of course) anytime within the **next 6** months!

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"Our whole family helped assemble this wonderful Schober Organ... now we all play it!"

Talk about real *family* fun! We all worked together, for a few hours almost every day. Almost too soon, our Schober Organ was finished. Our keen-eyed daughter sorted resistors. Mom soldered transistor sockets, although she'd never soldered anything before. And it did our hearts good to see the care with which our son—he's only 12—installed the transistors. Me? I was the quality control inspector—they let me do the final wiring. And when it came time to finish the beautiful walnut cabinet the easy Schober way, we all worked at it!

Now, we gather around our Schober Organ every evening to play and sing together. Some of us play better than the others, but we're all learning—with the help of the easy Schober Organ playing courses. I might add that I'm especially pleased with all the money we saved. Our completed Schober Organ compares favorably with a "ready-made" one costing twice as much! (The five models range from $650 to $2850.) And we didn't even need to pay the whole amount all at once, because we were able to buy Schober Kits a component at a time, to spread costs out. Or we could have had two-year time payments!

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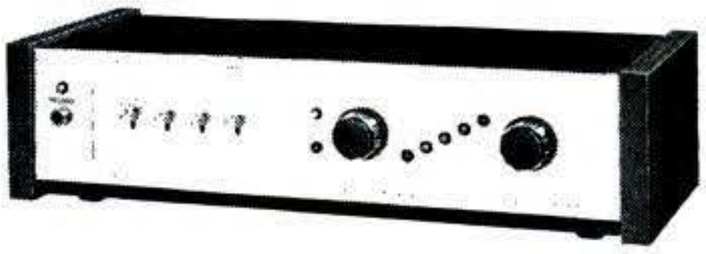

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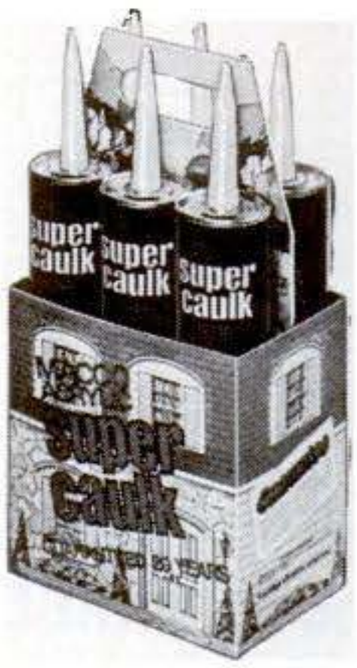

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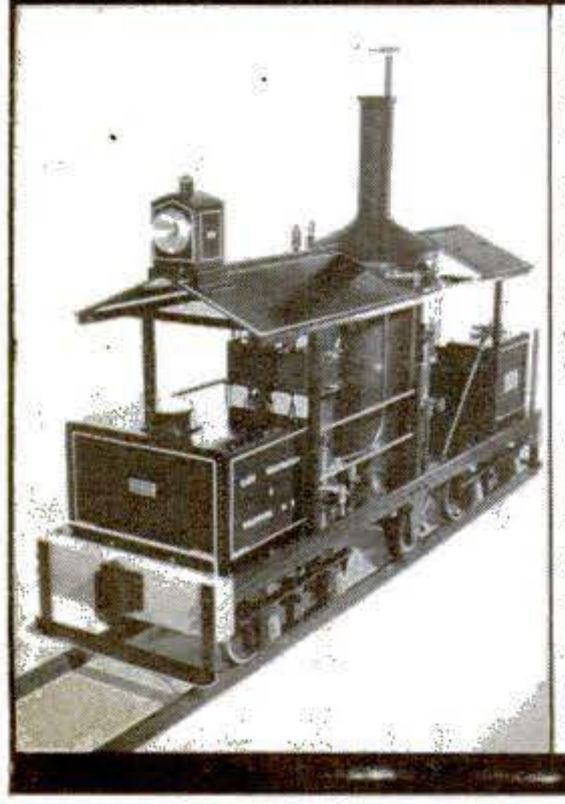

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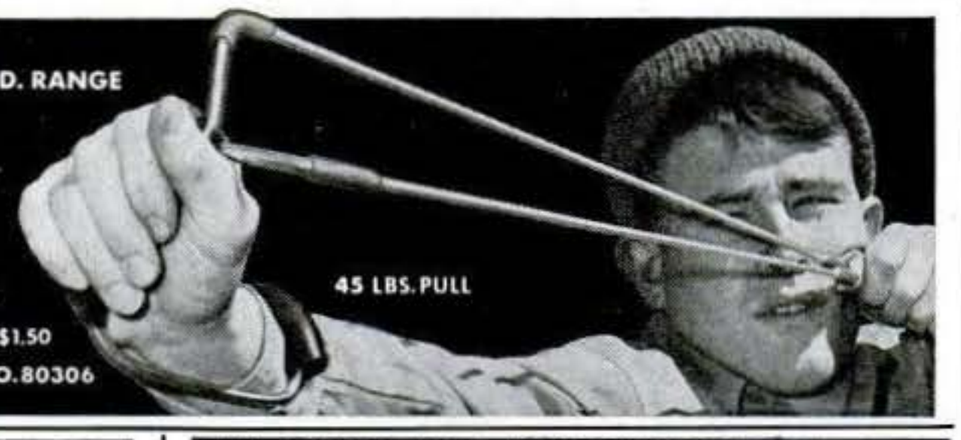

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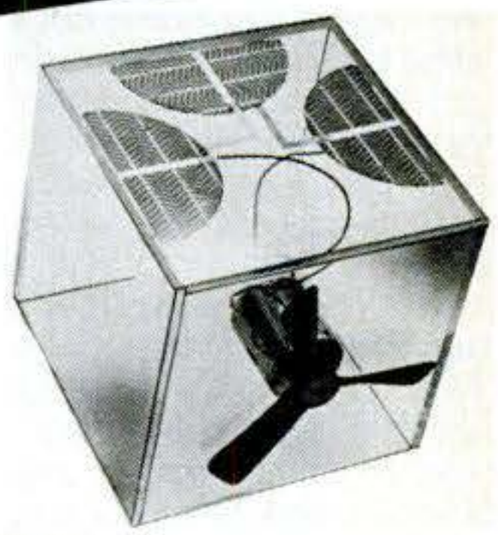

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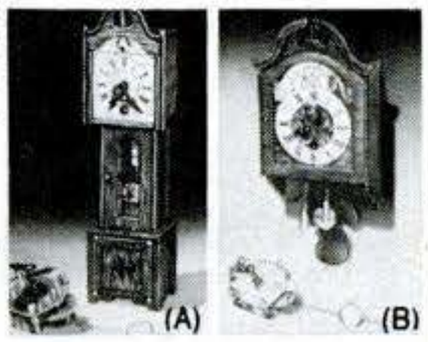

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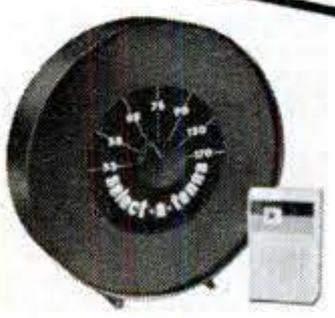

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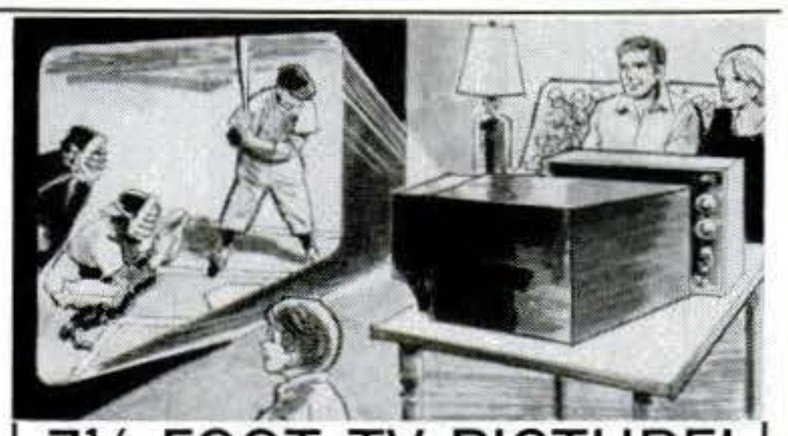

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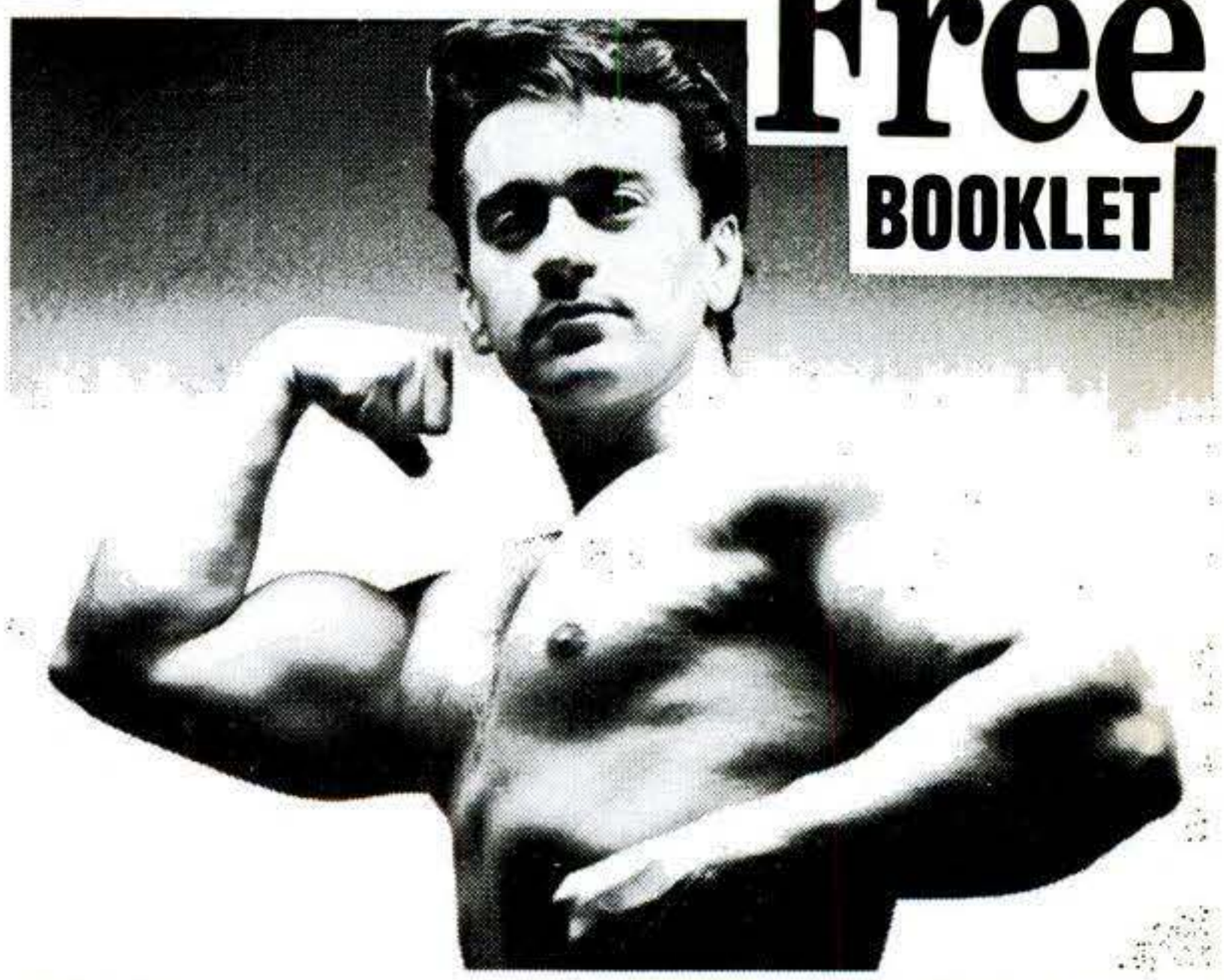


Free BOOKLET

MORRIE MITCHELL GAINED 65 POUNDS OF MUSCLE WHILE FOLLOWING OUR 'REVOLUTIONARY NEW METHODS' ON BODYBUILDING.

INTRODUCING

THE BODYBUILDING SYSTEM THAT **GUARANTEES** –

YOU'LL PUT ON INCHES OF POWERFUL MUSCLES ON YOUR BODY!

At last, NEW bodybuilding secrets are now available for your use. Finally, after years of experimenting we have come up with the fastest muscle building system in the world. Our course really works – **thousands** have taken our course and have obtained fantastic results. Right in the privacy or your own bedroom, you can completely transform your body.

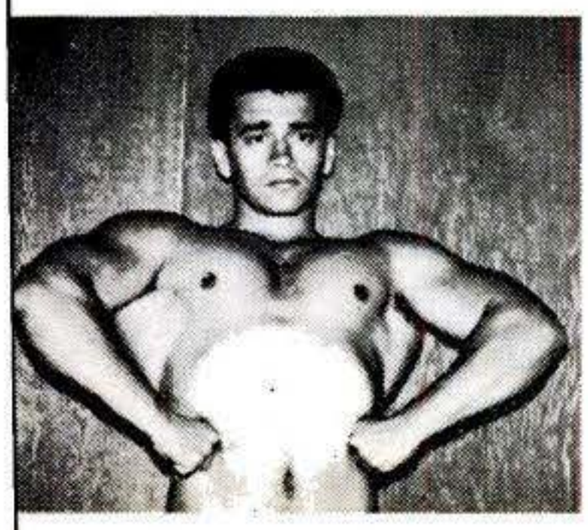
SEE YOUR MUSCLES GROW DAY BY DAY!

You can have POWERFUL MUSCLES FAST . . . not by years and years of hard work . . . but by simply following our fascinating system . . . a system that works so fast you can see results from day to day! Isn't that the kind of course you want? We absolutely guarantee results.

HERE ARE JUST A FEW OF THE LETTERS WE HAVE RECEIVED

"Wow! I'm making fantastic gains, following your new method of muscle building. I never knew it could be so easy to build muscles."
J. Johnson

"I was a skinny weakling when I enrolled, now I've gained 30 pounds in just 45 days. I am truly amazed, I'm going to be dynamite on the beach."
B. Abbott



"In just 3 weeks I have gained 1½" on my arms and 4" on my chest. I have also lost 4" off my waist. Your course is just great!"
D. Roberts

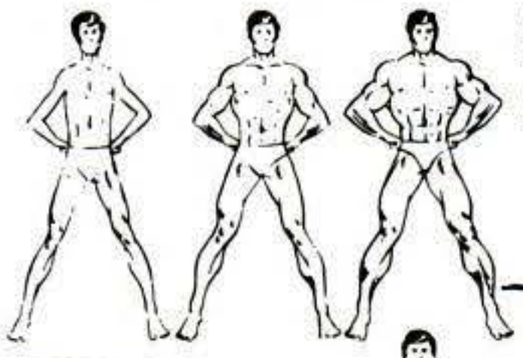
"I'm transforming all the fat off my body and changing it into rock-hard muscle. It's amazing I have lost 8" off my waist. I can actually see my muscles growing from day to day."
P. Williams

"I have gained 20 pounds in just 30 days and I have gained over 6 inches on my chest. I find that my power has doubled. In sports I am a winner in everything I do."
B. Daniels

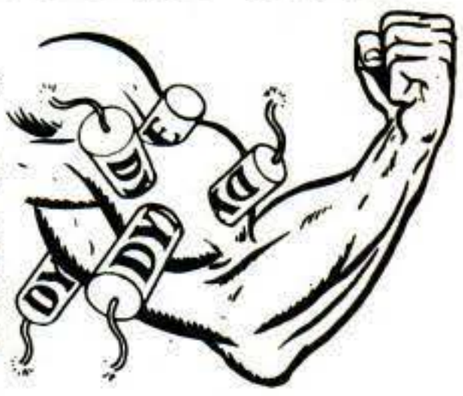
"I have gained 5" on my arms and 12" on my chest, while losing 3" off my waist. I have tripled my power and speed. Thanks for what you have done for me!"
M. Robinson

TAKE YOUR CHOICE! You Can Do This...

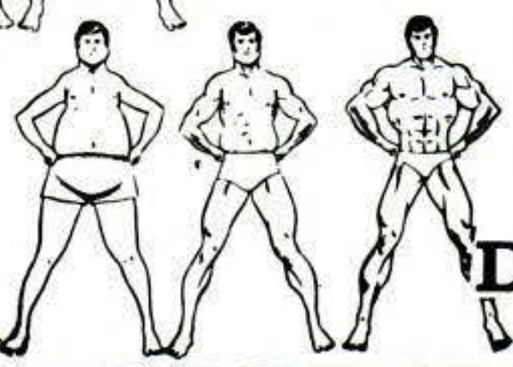
★ DOUBLE OR TRIPLE YOUR STRENGTH in record time! It wouldn't take long before you can perform feats of strength.



SKINNY?
MUSCLES WILL APPEAR . . . ALMOST LIKE MAGIC!



FAT?
FAT WILL DISAPPEAR – REPLACED BY MUSCLES!



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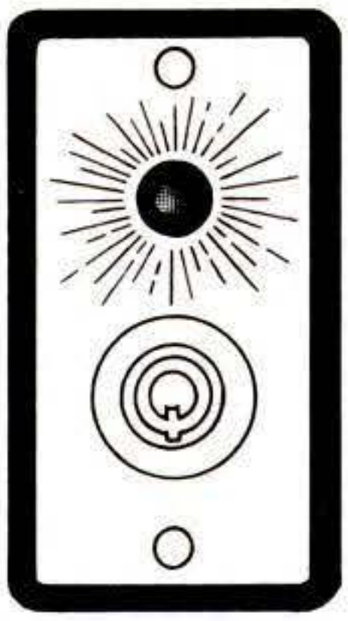
PROTECT YOUR FAMILY & HOME

keep burglars on the outside where you want them!

The visual presence of a key-activated light switch on a burglar alarm system establishes your home as no easy mark for a would-be burglar. An A.M.S. Burglar Deterrent System®, the original burglar deterrent system, is simply this — a key-activated light switch which installs easily on the outside of your home and achieves the same initial effect as the activator switch on burglar alarm systems costing thousands of dollars . . . but costs less.



When the light is on, there is virtually no way a burglar can tell whether the activator switch on the outside of your home is that of an expensive burglar alarm system or an A.M.S. Burglar Deterrent System®. The A.M.S. Burglar Deterrent System® operates on very low voltage, is easy to install, and comes complete with activator keys, warning stickers, and easy-to-follow instructions. All parts and materials are guaranteed.

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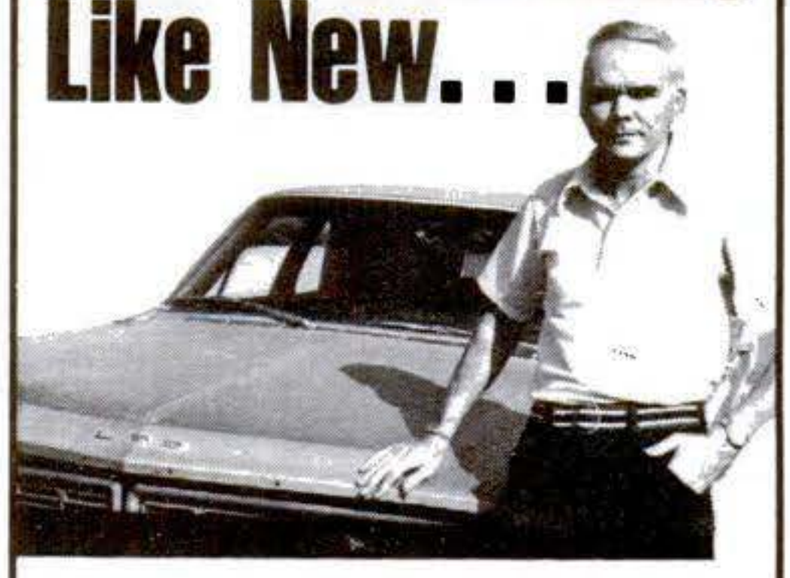

Thanks to QEI Gas, Oil, & ATF Blending Agents!"

"In fact, my 1968 Ford 390 wagon has never had any internal engine or transmission work. Mileage is 16 – city, 20 – hwy.; it uses 1 qt. of oil every 2,500 miles and I change my SD oil every 6,000 miles . . ."

Larry Krebaum

What are QEI Blending Agents? They are *not* just top oils or oil-thickening additives, but a balanced blend of petrochemical solvents and combustion catalysts designed to work *with* gasoline, crankcase oil, or automatic transmission fluid to remove and prevent the formation of harmful gums, varnish, carbon, and sludge. Over 5 years of industrial fleet experience and U.S. Government lab tests show these positive results —

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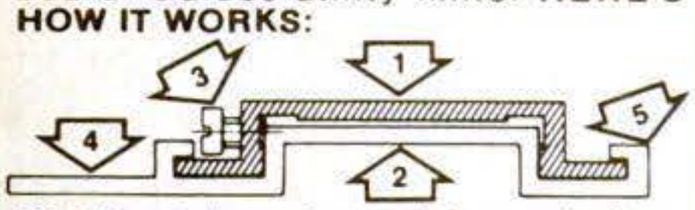
CUT STRAIGHT WITH 'STRATE-CUT' ™

A MUST FOR ALL POWER TOOL USERS

Use "STRATE-CUT" Cutting Guide with any portable circular saw, jig saw or router. **Extends to 8'6", reduces to 51"** for short cuts and portability. Clamps to paneling, doors and other long work. Rip 4'x8' sheets down the center; trim 1/16" off a door. Make precision 90° cuts, tapers, angles, dados, bevels, grooves. Unbeatable for scoring wallboard. Guides utility knife. **HERE'S HOW IT WORKS:**



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Portable Refrigeration breakthrough makes Ice chests Obsolete!

New Solid State Refrigeration Modules no bigger than your watch have More Cooling Power than a 10 lb. Block of Ice.

Your ice chest is bulky, awkward to carry, messy and inefficient at keeping its contents cold. You have to buy ice every day, if you can find it, throw away the spoiled soggy food and drain off the water *repeatedly*.

Conventional portable refrigerators are either too heavy, too noisy, drain your battery too quickly or need to be kept level.

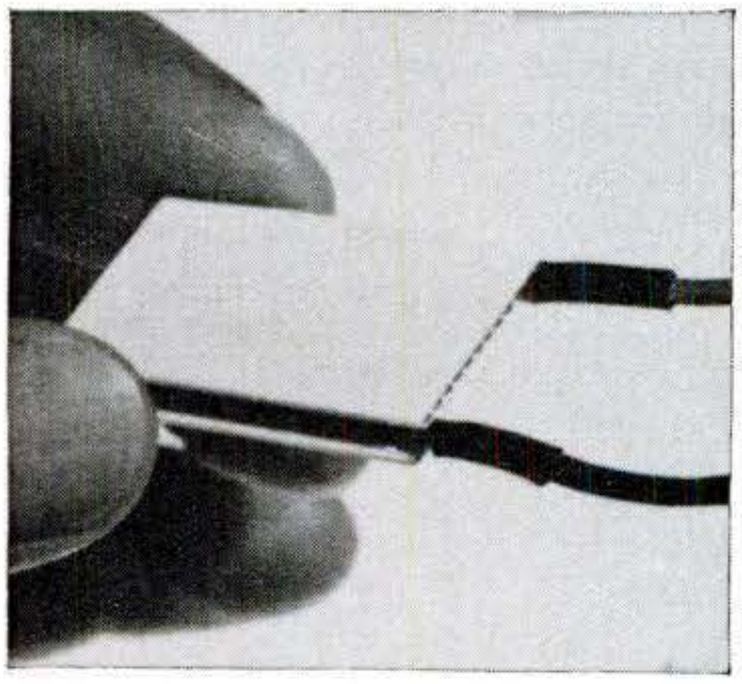
These problems and inconveniences have finally been resolved in one totally new product - the Frostpak 12 volt portable electronic refrigerator. We believe the Frostpak represents such a dramatic advance in refrigeration for recreational use that all existing methods are now outmoded.

USES AEROSPACE REFRIGERATION MODULES

The Frostpak cools your food electronically with solid state thermoelectric refrigeration modules. These same powerful modules are used by military and aerospace scientists to cool critical components in rockets and satellites. They use thermoelectric cooling because of its absolute reliability, insensitivity to motion or level, small size & weight and minimal battery drain. Only the Frostpak has these outstanding features.

WHY IS THE FROSTPAK SO MUCH BETTER THAN AN ICE CHEST?

A properly designed ice chest (ice on top) maintains an *air* temperature of 55-60 deg. F. Meat and milk spoil rapidly at temperatures above 50 deg. F. which is why the top of your meat will go bad even when it is sitting on ice. The Frostpak maintains normal home refrigeration temperatures of 40-45 deg. F. even in 95 deg. F. weather. You can also keep food frozen in air temperatures up to 80 deg. F.



Two of these miniaturized thermoelectric modules replace all the bulky complex piping coils, compressors and motors in conventional portable refrigerators. The modules pump heat from your food into efficient heat sinks where it is dissipated by a quiet fan. They operate on a principal called the "Peltier Effect" - passing electricity through the junction of dissimilar metals causes heat to flow from one metal to the other.

The new Frostpak keeps 40 lbs. of food at household refrigeration temperature but weighs only 15 lbs. Only 21" x 16" X 16" Ext.

THE ULTIMATE PORTABLE REFRIGERATOR

It weighs less than most coolers with a block of ice but holds 60, 10 oz. pop cans or 40 lbs. of food in its large 36 qt. capacity. Plug it in a lighter socket in your car, boat or van or operate it from a 12 volt battery charger plugged into 110 V.A.C. A fully charged 90 amp/hr battery will provide 1 to 3 days of refrigeration depending on your weather. Draws a maximum of 4 amps., averages about 2 amps. at 70 deg. F. with the thermostat on. Keeps your food cold and dry. You can keep beverage ice for days in a plastic container.

AMAZING VARIETY OF USES

Fits into virtually any boat, van or camper. Carry it on the back seat during car trips. Ideal for fishing and hunting - bring your catch back home fresh (a few loads of fish fillets could pay for your Frostpak). Use it for grocery shopping, medicines, carrying film, salesmen's samples. Take it to the drive-in movies, auto races and other sporting events. With an inexpensive battery charger you can use your Frostpak as a bar fridge all winter and a patio fridge in the summer. Run it in your motel room at night and enjoy a midnight snack whenever you feel like it. We have customers using Frostpaks on construction sites, in workboats, laboratories and even in locker rooms for a "cold one" after the game. Even sailboats with no engine can enjoy refrigeration if they have dock power to recharge with.

BUILT-IN QUALITY AND DURABILITY

The rugged "ABS" case is filled with the best insulation available - rigid urethane foam. It has a "150 lb. test " handle and non-rusting polypropylene hinge and latches, with stainless steel fasteners. The exterior is harvest gold with a white interior and has 4 non-slip rubber feet. Your Frostpak comes with a 9 ft. detachable cord which plugs into your cigarette lighter and has terminal posts for attaching wires directly from a battery or fuse panel. The same terminals are used for your battery charger clips when operating from a charger. A reverse polarity warning light & buzzer are included. The Frostpak was designed so that the fan motor and thermostat can both be replaced by you with only a screwdriver. No other service should ever be required except for physical damage which can be repaired at our depots in Batavia, N.Y. or Barrie, Ontario.

ONE YEAR WRITTEN GUARANTEE

Your Frostpak comes with a written 1 year guarantee plus complete instructions and helpful information about batteries and chargers. If you need help or advice anytime, you can call or write Bey Reed, General Manager or Andy Smith, Production Manager for personal service.

21 DAY MONEY-BACK TRIAL PERIOD

If for any reason you are not totally satisfied with your Frostpak, return it for a prompt refund in full. We have received many kind letters from our customers praising their Frostpaks and would appreciate hearing from you.

BUY FACTORY-DIRECT AND SAVE

By selling factory direct to you we can offer you your Frostpak at the incredibly low "off-season" discount price of only $159.00 + shipping ($169.00 in Canada). This is $30.00 below our regular price of $189.00. The Frostpak is not available from large retailers or distributors. Due to the high cost of thermoelectrics, we would have to price it well over $200.00 to provide the required distributor discounts. We prefer to give the discount directly to you.

PAYS FOR ITSELF

If you are regularly using ice, your Frostpak will pay for itself with the money you save on ice, spoiled food, restaurant bills and the gasoline used looking for ice.

DON'T WASTE ANOTHER NICKEL ON ICE!

Phone your order in collect to

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or use this handy order coupon.

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Send me _____ Frostpak(s) $159.00 ($169.00 in Canada) + $5.00 each for delivery in U.S.A. or Canada (N.Y. & Ont. residents add sales tax).

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New Sinclair Cambridge Programmable

An astonishing $29.95!

How pocket calculators grew up

A couple of years ago, calculators took a step forward. Programmability transformed the slick slide-rule calculator into an advanced scientific machine.

Sadly, it also transformed a cheap little calculating aid into a piece of capital investment.

Now the all-new Sinclair Cambridge Programmable puts programmability where it belongs: in the palm of your hand, for less than $30.

The features of the Sinclair Cambridge Programmable

The Cambridge Programmable is genuinely pocketable. A mere 4½" x 2", it weighs about 2oz.

Yet there is absolutely no compromise in the package of functions it offers.

Because the Cambridge Programmable is both *a scientific calculator* with memory, algebraic logic and brackets (which means you enter a calculation exactly as you write it), and a *programmable calculator* which offers simple, flexible through-the-keyboard program entry and operation.

The Cambridge Programmable has a 36-step program memory, and features conditional and unconditional branch instructions (*go to* and *go if negative*).

There is also a step facility, which allows you to step through the program to check that it has been entered correctly. If there is any programming error, the learn key allows you to correct single steps without destroying any of the remainder of the program.

To achieve this, each program key-stroke has an identifying code, or 'check symbol'. (The symbols for the digit keys are the digits themselves, while the symbols for the operator keys are letters printed beside the keys.)

The check symbol for ⊟, for example, is F. So if, as you step through the program, the display shows

it means that ⊟ is programmed as step 26. If step 26 should have been ⊞, all you have to do is press

learn

▲/▼ RUN +

puts machine into 'learn' mode. **the correct step**

It's as simple as that!

Use the 294-program library to tailor the machine to your own speciality

Like a full-size computer – and *unlike* far more expensive specialist calculators – the Sinclair Cambridge Programmable can be programmed to handle calculations concerned with *any* speciality.

It can even be given to an operator who doesn't understand the program!

To save you time, and to help inexperienced programmers, Sinclair have produced a library of 294 programs ready to be entered straight into the calculator.

Using these standard programs, the Cambridge Programmable solves problems from quadratic equations (where the program gives both real and imaginary roots) to twin-T filter design, and from linear regression to bond yields.

(The calculator is supplied with 12 sample programs, and full instructions for entering your own program. The four books in the program library are available at $4 each, or $10 for the complete set.)

A home computer – great education, and great fun!

The Programmable is a true computer in miniature.

An hour or two spent with it gives more insight than any plodding text book into the way computers work.

Great for children – and children find it easy to understand. What's more, the library *shows* you how to have fun with your computer. There's a 'matchstick' game (where you can *win*) and a real lunar landing program to run. (Right decisions – soft landing. Wrong decisions – disaster!)

The approach is so simple, and so immediate, that writing your own programs becomes an absorbing addiction. (New programs written by owners reach us all the tim – send us yours, and we'll publish them.)

Why the Cambridge Programmable costs so little

The Sinclair Cambridge Programmable uses the Sinclair talent for miniaturisation to the full – as you'd expect from the company that pioneered the truly pocketable pocket calculator, and recently introduced the world's first pocket TV.

Chip and circuitry design are unique to Sinclair, and the Cambridge Programmable is assembled by Sinclair's own staff at their headquarters plant.

The results is a pocket programmable calculator of advanced design, sold by the manufacturer with the manufacturer's own 1-year comprehensive guarantee, at a price unmatched by any comparable calculator.

10-day no-obligation offer

There's a lot more to this remarkable calculator than a brief written description can cover.

You need to see it and handle it... t program it yourself in a few seconds to save you hours... to check its performance against tables and graphs... to test the full range of programs available.

So we're offering a 10-day trial. Send your check or money order with the order form below, and you'll receive a calculator direct. Use it for 10 days, and if you don't feel it's the finest $29.95 you've ever invested, send it back. We'll refund your money without question.

There's nothing to lose, and so much calculating power to gain.

Post your order today.

sinclair

Sinclair Radionics Inc., Galleria, 115 East 57th Street, New York, N.Y. 10022 U Tel: (212) 355 5005.

To: Sinclair Radionics Inc., Galleria, 115 East 57th Street, New York, N.Y. 10022, USA.

Please send me_____(qty) Sinclair Cambridge Programmable(s) at $29.95 each, including full instructions, and sample programs. $_____

_____ (qty) AC line adaptor(s) at $4.95 $_____

_____ (qty) Program Library **Book 1** at $4 $_____
General/Finance/Statistics (percentage, metric system, memory, games, dates, finance, mortgages, statistics)

_____ (qty) Program Library **Book 2** at $4 $_____
Mathematics (algebra, calculus, geometry, trigonometry, number theory, transcendental functions)

_____ (qty) Program Library **Book 3** at $4 $_____
Physics and Engineering (astronomy, statics and dynamics, relativity, mechanics, properties of matter, fluids, structures, thermodynamics)

_____ (qty) Program Library **Book 4** at $4 $_____
Electronics (networks, circuits, filters, electrodynamics, radiation and propagation)

_____ **(qty) complete set(s) of 4 books at $10 per set** $_____

Sales tax (NY residents) $_____

Post and packing $ 2.50

Total $_____

Enclosed is check/MO payable to Sinclair Radionics Inc.

Name _____

Address _____

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City _____

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(PLEASE PRINT)

I understand that you will refund purchase price in full if I return calculator(s) and accessories in saleable condition within 10 days of receipt.

Signature _____

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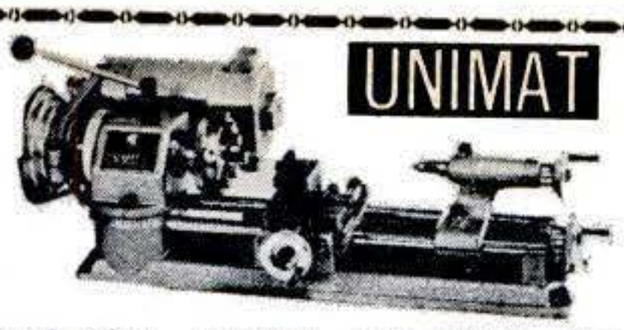

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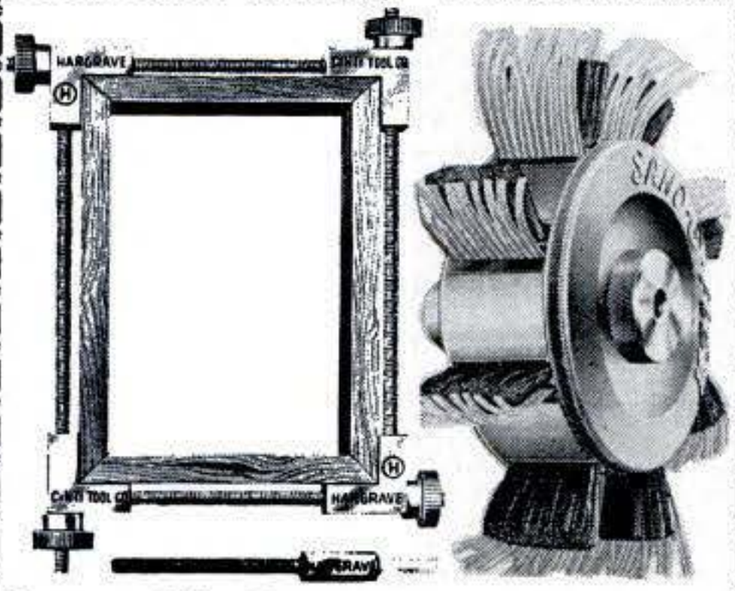
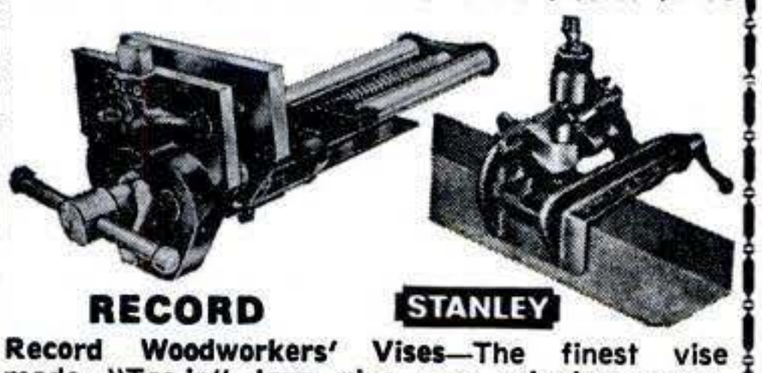
1000-A3 Unimat 5-in-1 shop **$184.50**



Hargrave Miter Frame Clamp—Clamps all four corners at one time. Quickly adjusted. Absolutely accurate. Aluminum alloy corner blocks. Screws and adjusting nuts are steel. Capacity 2 to 14" Add $1.00 for shipping.
780-C15 Miter Frame Clamp **$11.25**

Hargrave Extension Screws—Each set increases capacity of No. 780 clamp 12". Any number of extensions may be used. No. 780-E available only in sets of four.
780E-C15 Set of 4 Extension Screws **$5.29**

Sand-O-Flex Contour Sander Kit—For curved or flat surfaces. Firm cushioning bristles force abrasive strips into, around and over corners, small openings, convex and concave surfaces. Aluminum wheel contains 80" to 150" of abrasive cloth strips, which is fed out as used. Use on metal, wood, fiberglass or ceramics. No job too tough. Kit contains #350-R wheel, 6" dia. x 1" wide by ⅝" bore, 3 abrasive refills in assorted grits for wood or metal sanding, ¼" shank adapter to fit chucks, and an arbor reducer bushing ⅝" to ½" included. Add $1.50—Reg. $24.95.
35-M2 Sand-O-Flex Sander **$17.98**



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52D-R10 7" Vise—22 lbs. **$34.50**
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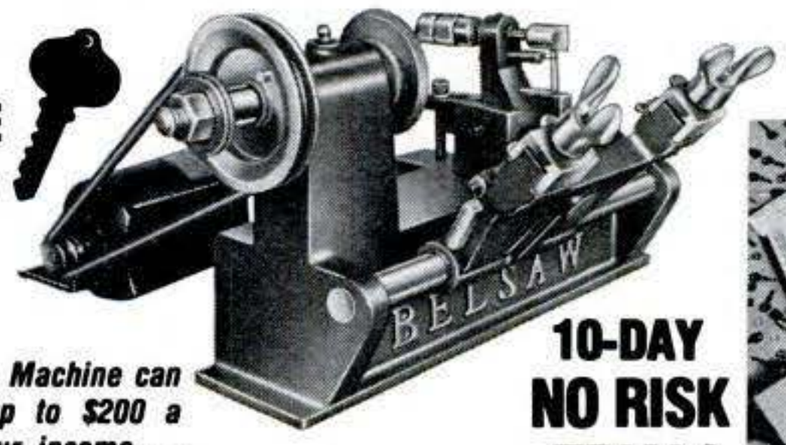

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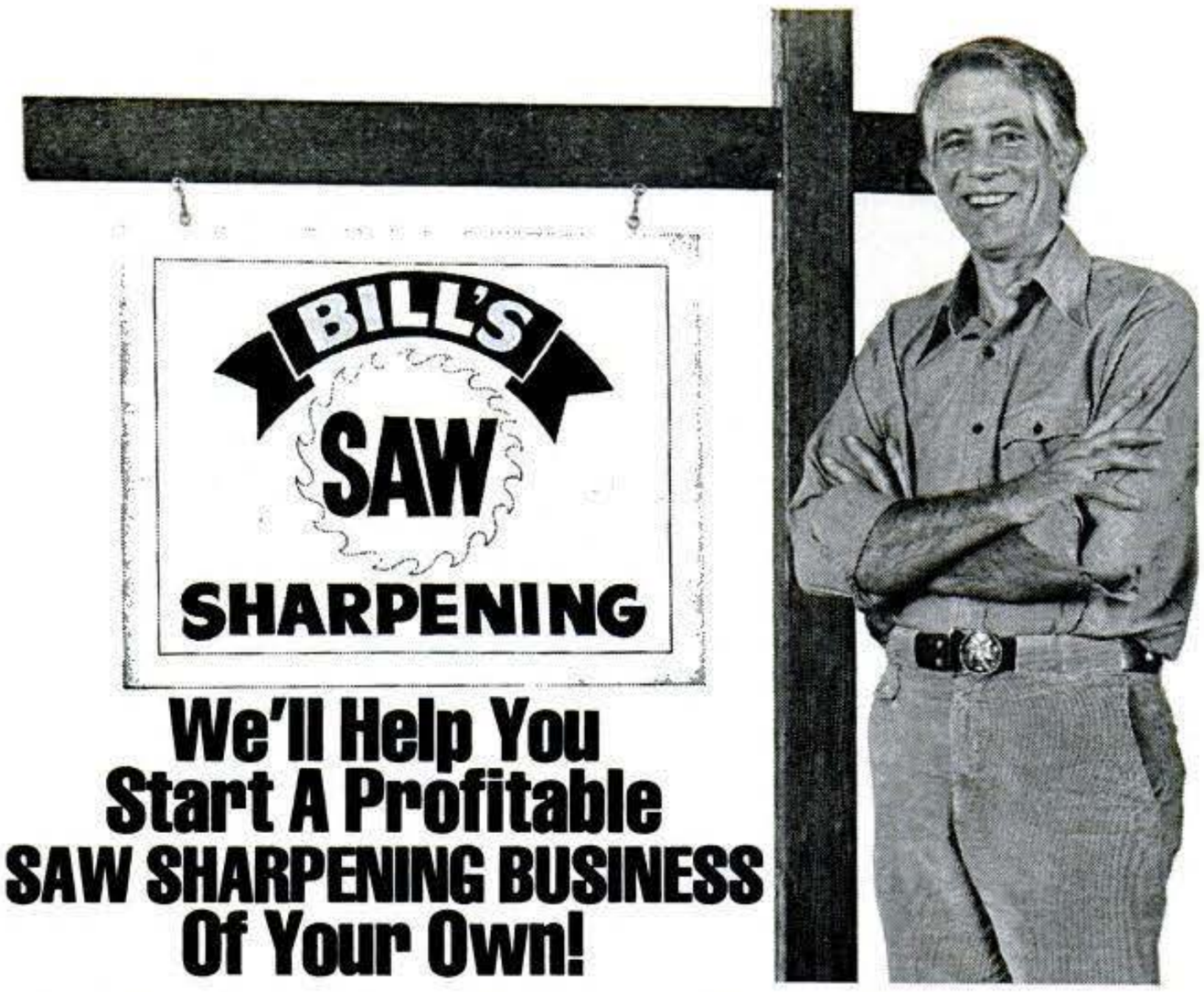

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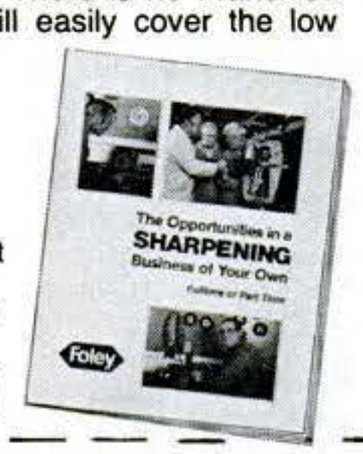

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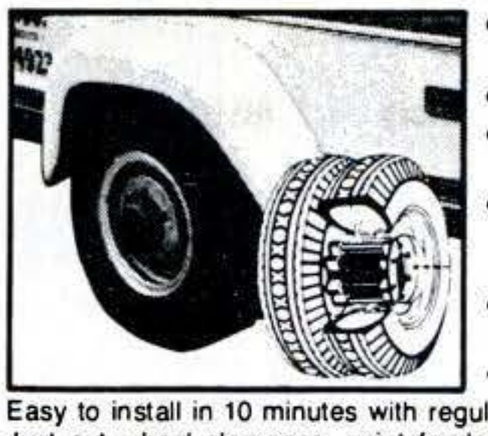

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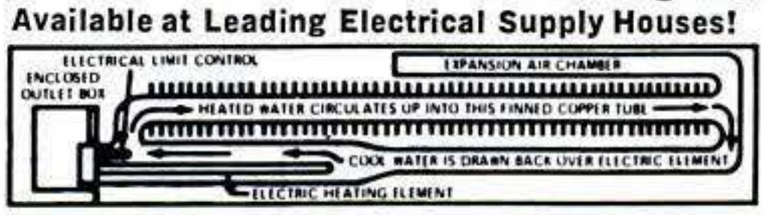

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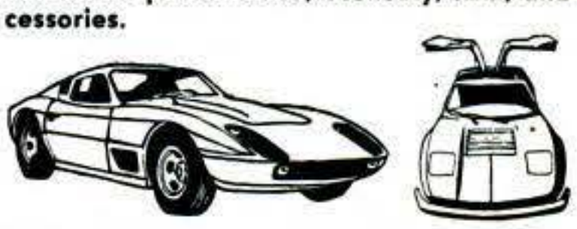

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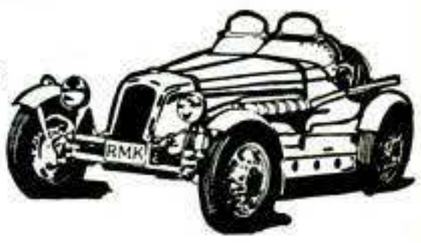

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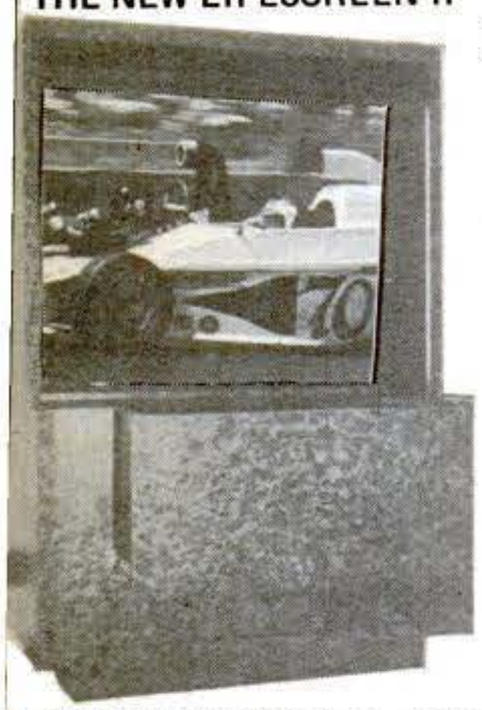

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The special LIFESCREEN, Lens and Front Surface mirror supplied by Extron are the same type used by major Big Screen TV manufacturers (Sony, Muntz, etc.). THESE PROFESSIONAL COMPONENTS SHOULD NOT BE CONFUSED WITH THE CHEAP PLASTIC MAGNIFYING IMITATIONS NOW FLOODING THE MARKET BECAUSE OF THE POPULARITY OF BIG SCREEN TV.

The EXTRON TV Screen — the same used by the major Big Screen TV manufacturers — is 16 TIMES BRIGHTER than a flat matte surface and 6 TIMES BRIGHTER than most flat beaded movie screens. Its parabolic shape rejects extraneous light, concentrating a highly efficient and directionally selective television image that is exceptionally sharp and colorful.

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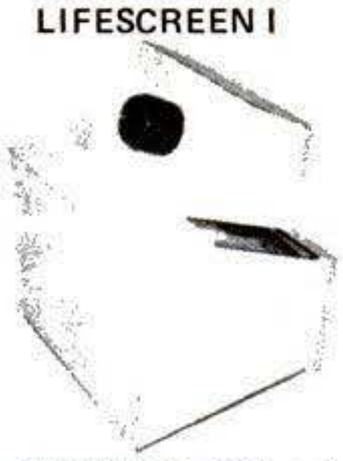
COMPLETE LIFESCREEN I PACKAGE: **$269**

THE ORIGINAL LIFESCREEN I



The INDEPENDENT projection system that can be used with ANY SIZE screen up to 80" Diagonal — one of the many reasons for its tremendous success.

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LARGER SCREENS can be ordered through EXTRON (67" or 80" Diag.)

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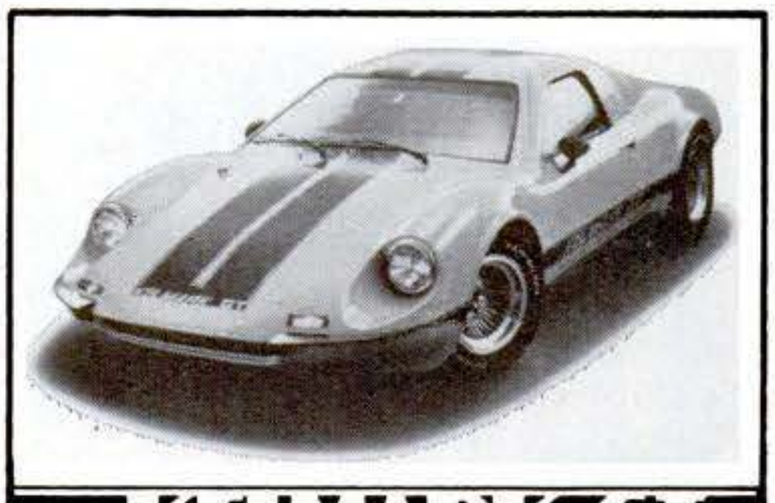

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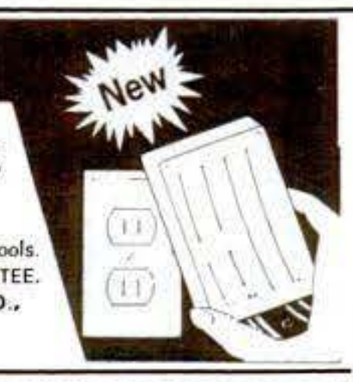

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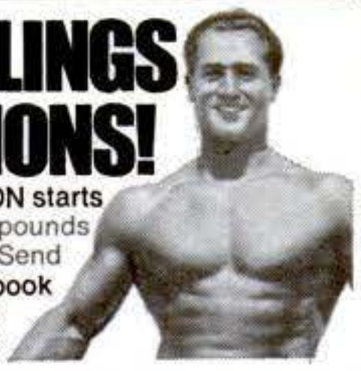

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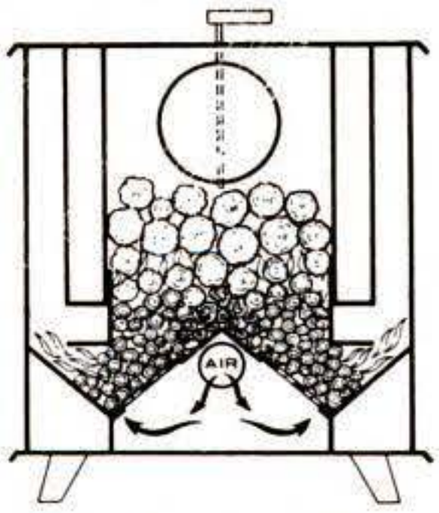

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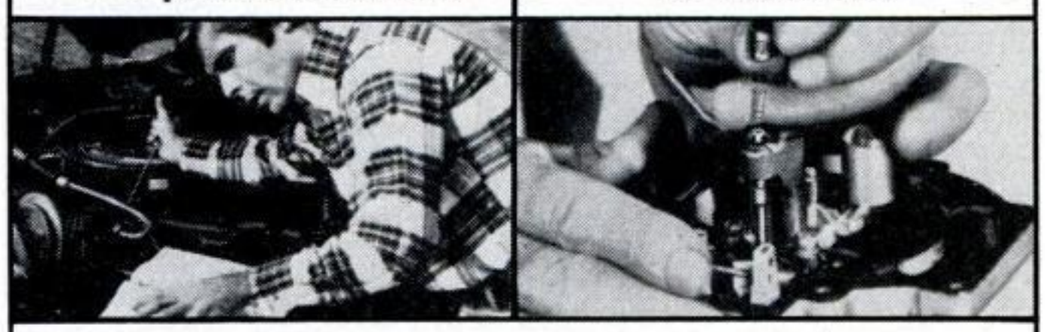

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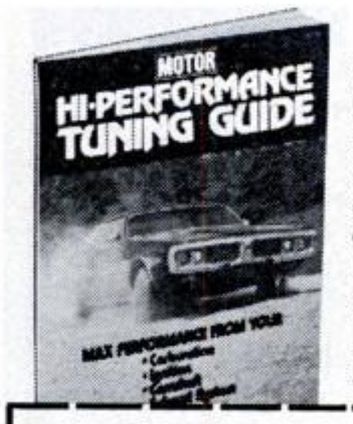

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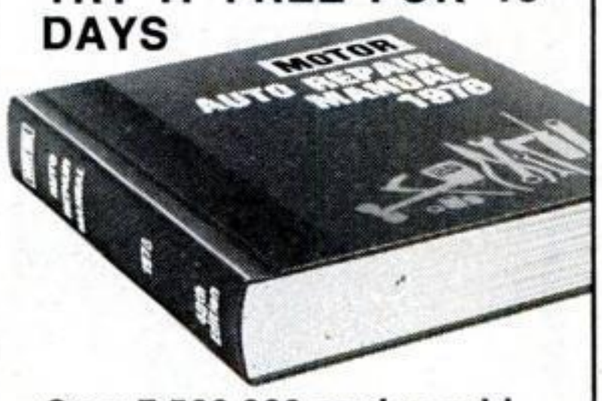

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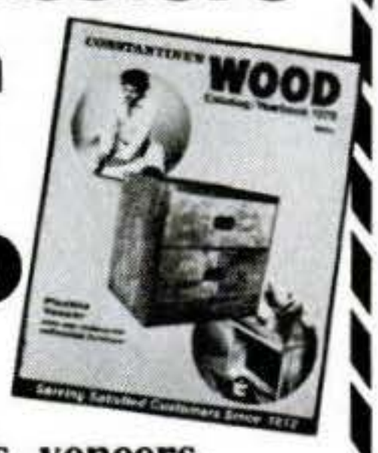

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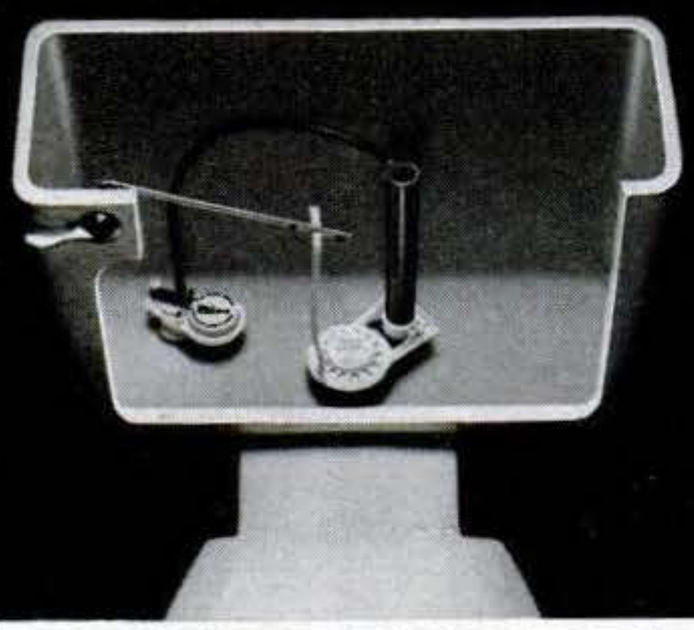

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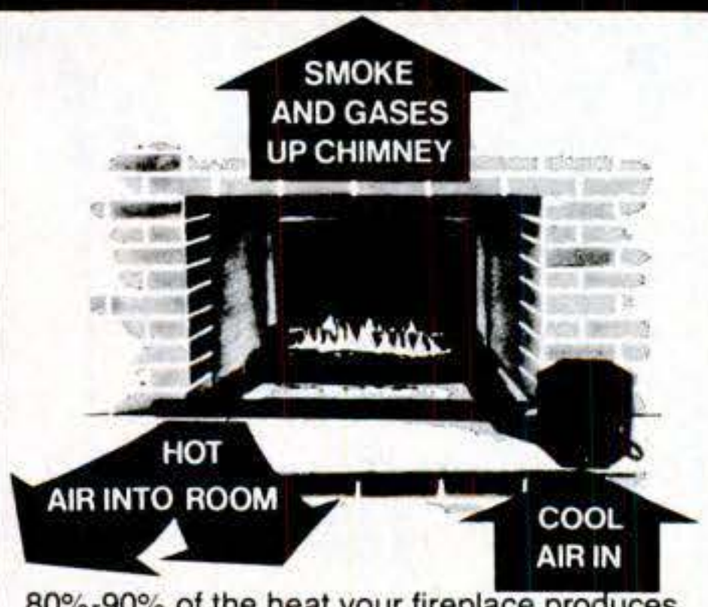

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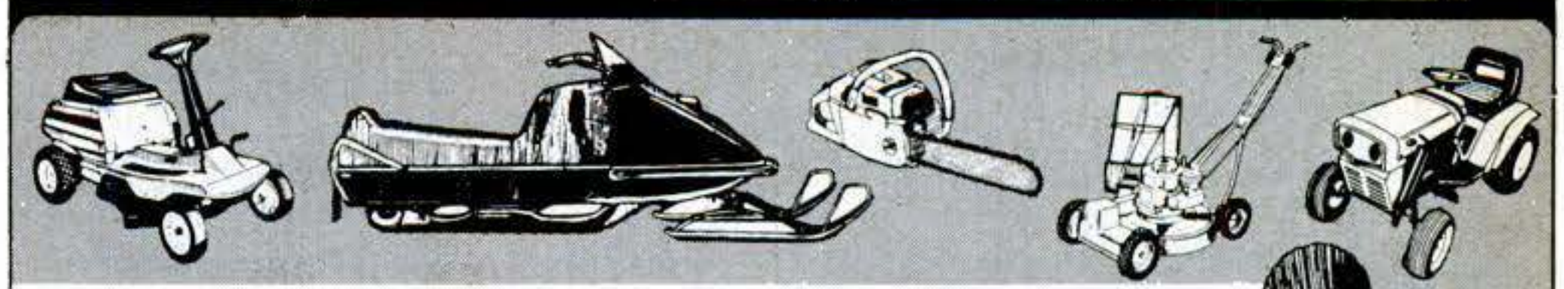

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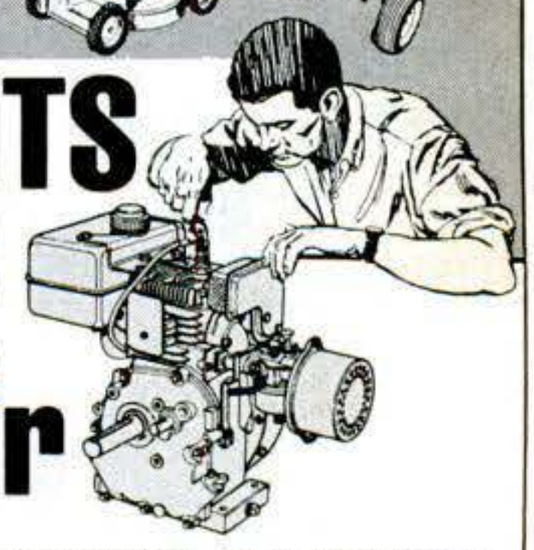

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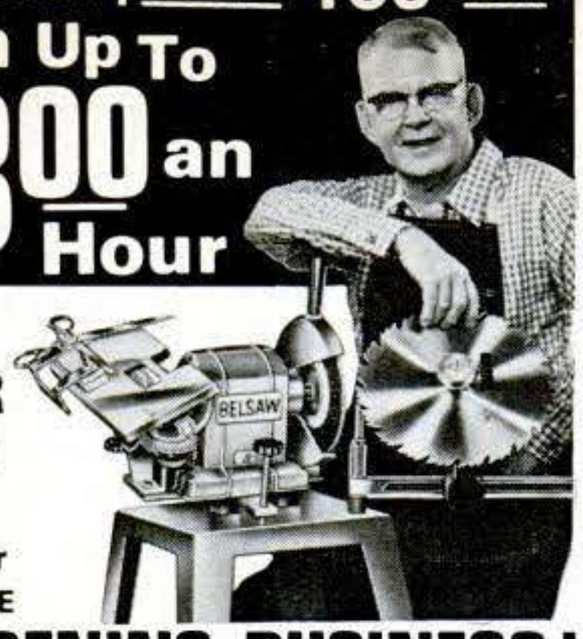

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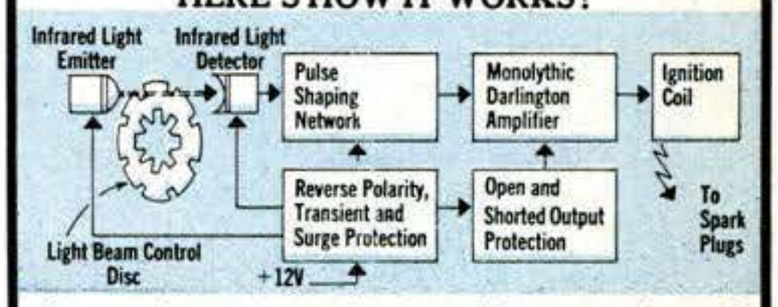

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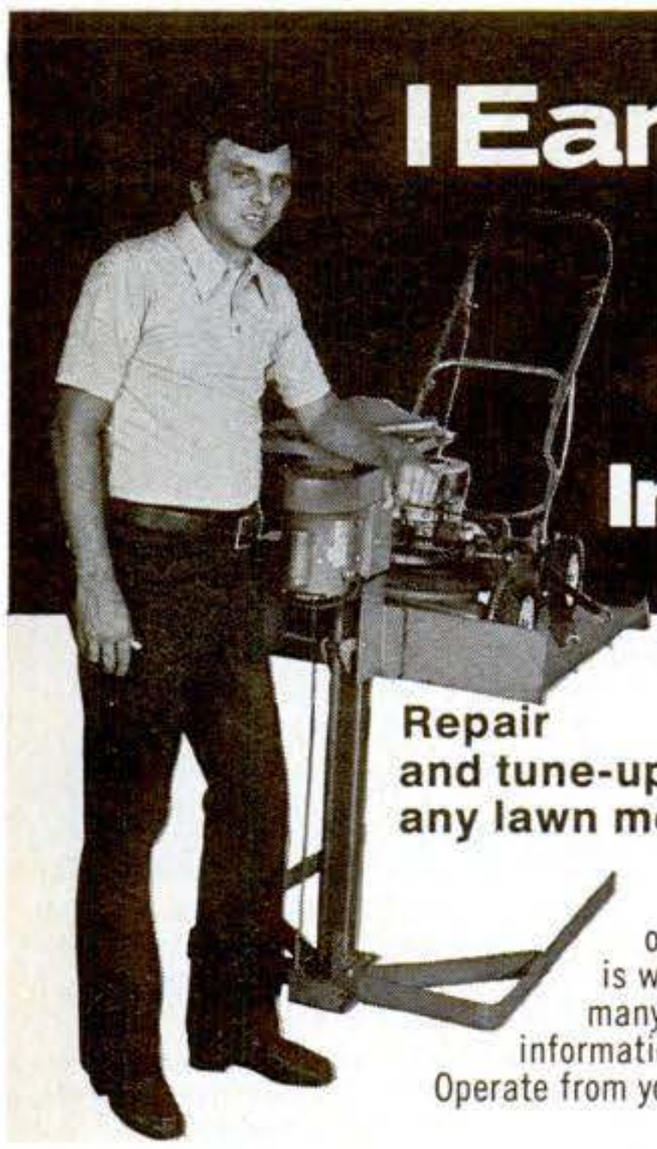

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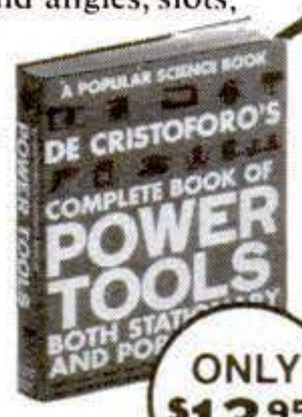

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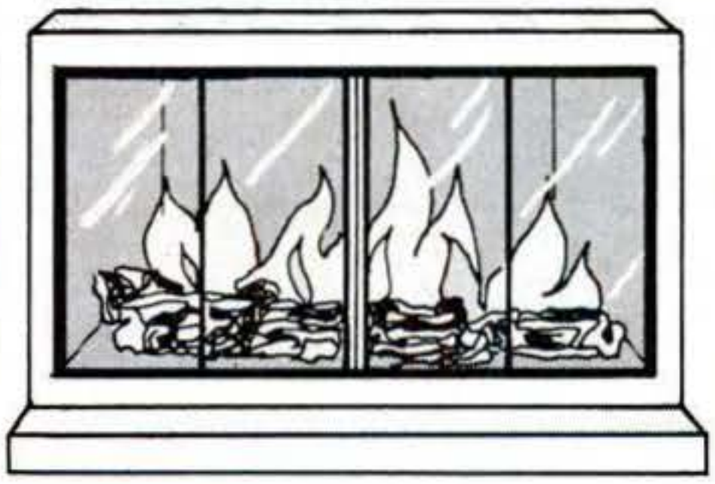

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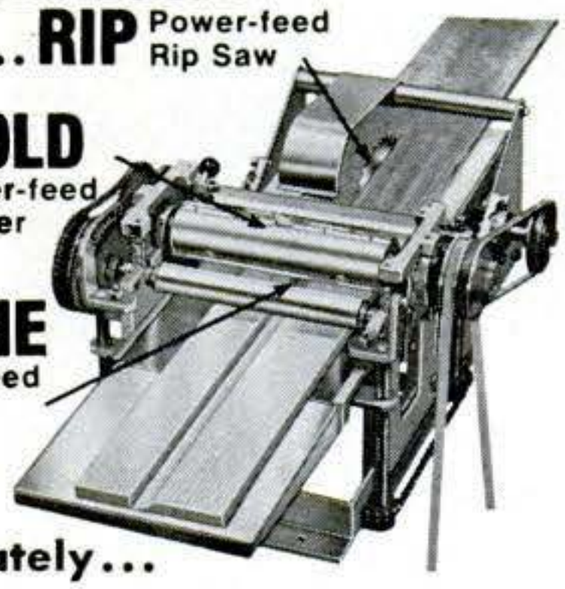

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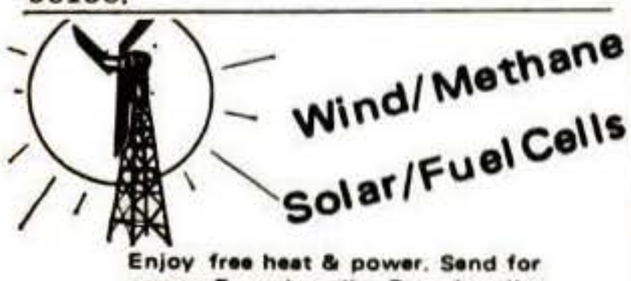

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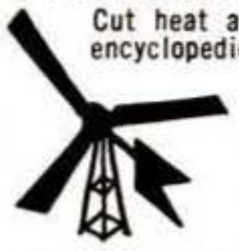

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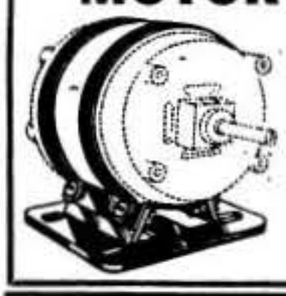

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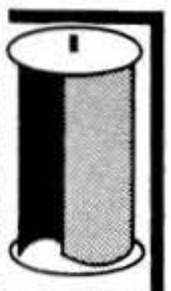

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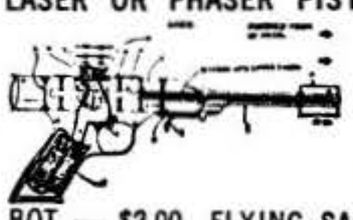

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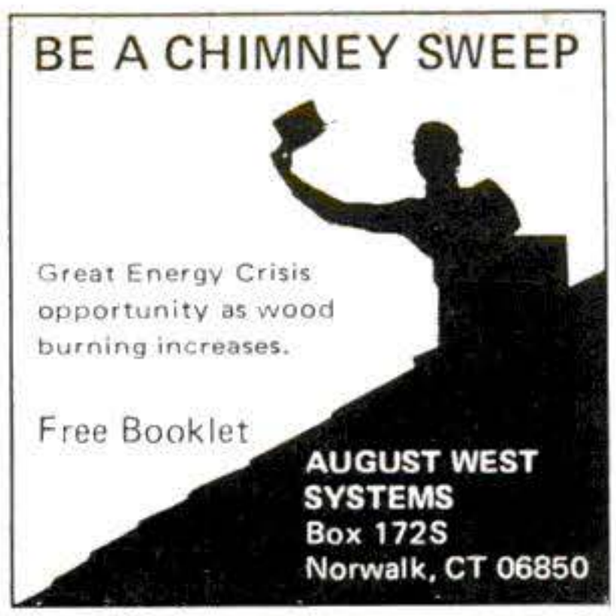

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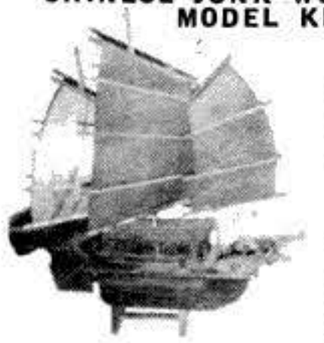

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A&E Systems' six-page color brochure describes RV awnings, electrical-jack systems, tank and tire covers, and more accessories. Free

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1005 Staple-down Vinyl Flooring
Do-it-yourself guide to fast, easy installation of vinyl floors that can be used anywhere. Choice of designs are illustrated in color. From Armstrong. Free

1006 Home Computer Ideas
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Booklet describes the unlimited uses of CRC spray for home, auto sports, and business. A time- and money-saver for the do-it-yourselfer. Free

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Grumman brochure describes the many applications of solar energy with performance specifications, cutaway of collector, and diagram of domestic solar hot-water system. Free

1014 Climate Control
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Booklet describes the PanaVise work-positioner system that has four bases and five interchangeable heads. Free

1017 Radiator Cap Brochure
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1018 Gas-Leak Detector
This brochure describes the Rosan gas-leak detector for RV's. Also included is an RV-safety checklist. Free

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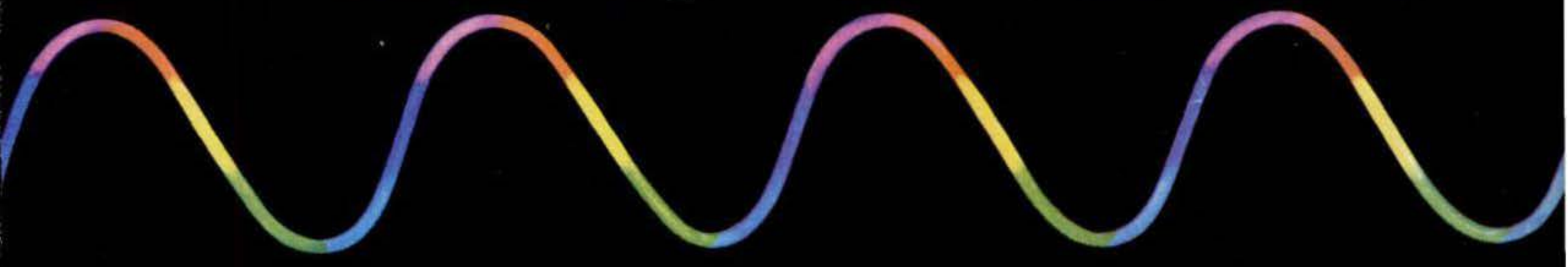

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